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Preface

This issue is a multidisciplinary volume in the field of technical and educational science with 8 articles. This issue supports these aspirations with several aspects which appear in the papers.

Nazmi Xhomara, Tomi Treska and Vahidije Kadiu evaluate the correlation between instruction time and student's school attitude in Albania and European Countries. The study demonstrates a positive correlation between curriculum instruction time and the students' school attitude.

Tünde Lengyel Molnár presents digital applications suitable for sharing the reading experience that can be used not only within the frames of formal classes, but in non-formal education as well. The paper presents concrete feasibility options and analyse them based on their practical benefits.

Sanja Maravic Cisar and Robert Pinter evaluate the dropout rate at Subotica Tech to determine the dynamics of the study and to detect the critical points of the teaching process which lead to problems and finding the best way to eliminate them.

Beáta Orosz et al. deal with the digital cooperative environments and the aspects of tendencies and phenomena generated by digitalization and introduce its immediate, practical impact on the teaching and learning process and they emphasize such key competences, which are relevant and crucial for the support of digitalization in the 21st century.

Cristina Costescu and Adrian Marian Rosan develop an assessment protocol, which could identify if there are differences in the way individuals with low autism spectrum traits and high autism spectrum traits process written social information using eye-tracking based evaluation. This information may help to specify the development of educational techniques for individuals with autism spectrum disorder.

Éva Kovács-Bokor and Endre Domokos investigate the accumulation ratio of metal oxides, mainly lead- and zinc oxides within the main parts of the examined plants with phytoextraction processes and showing the positive effect on the decreasing of the metal content of the sludge-soil mixtures. The investigation was implemented with the collaboration of students, who gained practical knowledge in sample preparation, analysis and data evaluation.

Miklós Póth and Željen Trpovski shows how different parameters of the JPEG compression algorithm influence the performance of the compression.

Patrik Elter, Anita Sabo, Tibor Szakáll and Bojan Kuljic present an instrument used in EMC measurement on a training model and then to evaluate the measured results according to the given standards.

Petar Cisar and Robert Pinter give a general overview of some Kali attacking possibilities on client and server side and highlights their specificities.

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Attila Kovari, editor of this issue

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Correlation between instruction time and student's school attitude: Albania vs European Countries

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Abstract

The purpose of the study is to investigate the relationship between curriculum instruction time and student' school attitude. A mixed research approach was used in the study. The random-cluster samples of students, teachers, principals, and curriculum specialists were selected to be used in the research. The qualitative approach, including a review of official documentation as well as interviewing, was used to support a quantitative approach in the study. The descriptive analysis and a bivariate correlation statistic were used for the processing of data, and the inductive open coding and the typology techniques were used to analyse the qualitative data. It is found that there are differences in instruction time between European countries and Albania. At the same time, the results showed that there is a relatively non-adequate student's school attitude in lower secondary education. The study demonstrated that there is a positive correlation between curriculum instruction time and the students' school attitude. It is one of a very small number of studies in curriculum instruction time to provide such results.

Keywords: curriculum instruction time; student's school attitude; curriculum area; key stage

1. Introduction

Curriculum instruction time constitutes a significant factor that supposed to affect academic success, including students' school attitude. The students 'school attitude comprises the degrees of behavioural and recognition engagement towards the school. Students 'school attitude represents the student's positive or negative feelings towards the school. Tyler (1949) pointed out that the curriculum must include: aims and objectives of the school, educational experiences under these aims, experiences, and assessment. Taba (1962) described seven stages in her base model: needs assessment, designing objectives, the choice of content, the organization of content, selection of learning experiences, the organization of educational

activities, evaluation, and assessment tools. Ornstein and Hunkins (2003; 2017) stated that the curriculum means: a plan for action or a written document, a field that addresses students' experiences, linear or nonlinear system, academic and theoretical study, specific courses, a plan for achieving goals- a linear view of curriculum.

The curriculum is an organized set of formal education and training intentions, a development process that: identifies a philosophy, assesses student ability, considers the possible methods of instruction, implements strategies, select assessment devices, and is continually adjusted (Saylor, Alexander, & Lewis, 1981; Wiles & Boundy, 2014). The core curriculum normally includes courses that should be studied by all students [Instituti i Zhvillimit të Arsimit], 2015). Therefore, the study of curriculum matters is important for the academic success of the students. *The aim* of the study is to investigate the relationships between curriculum instruction time and students' school attitude. The quantitative research questions of the study, including: Is *there a–significant correlation between annual instruction days and students' school attitude? Is there a-significant correlation between week instruction days and students' school attitude? Is there a significant correlation between classes' instruction minutes and students' school attitude?* Meanwhile, the qualitative research question is as follows: is instruction time enough to address the aims and objectives of the competency-based curriculum in different curriculum areas?

2. Theoretical framework and literature review

2.1. Conceptual framework

Tyler (1949), as well as Taba (1962) curriculum theories were used as a basis to conceptualize a research framework for this study. Tyler and Taba curriculum approach is usually based on a plan, sometimes called a blueprint or document. Goals and objectives are specified, content and activities are sequenced to coincide with the objectives, and learning outcomes are evaluated in relation to the goals and objectives. The approach has also been called logical, conceptual- empiricist, experientialist, rational-scientific, and technocratic (Pinar, 1978). The theoretical framework is based on an extensive review of existing evidence about curriculum instruction time in schools. The research is based on relevant empirical research through ERIC, Sage, and EBSCO, using the keywords "curriculum instruction time", and "students' school attitude". Figure 1 summarizes the results from the review and proposes a set of relationships among the two constructs. Curriculum instruction time, divided as annual

instruction days, week instruction days, and classes' instruction time, is considered an independent variable, and students' school attitude is considered a dependent variable.

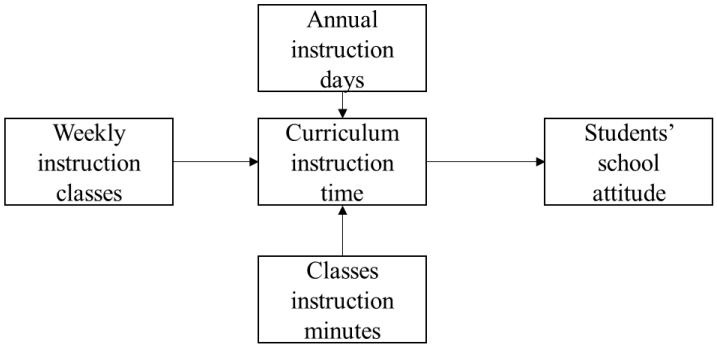

Fig. 1. Conceptual framework

2.2. Curriculum instruction time

An important part of the instruction time management is the logical report correlation between curriculum areas in a key stage as well as between key stages. Target curriculum, its aims, structure, courses and conceptual students' loads are based on guidelines and regulations, as well as on standards set by the authorities. Students at certain levels can make choices among a group of optional-courses of the core curriculum; on the other hand, a flexible core curriculum is included in the compulsory instruction time. In some European countries, curriculum documents include only the national curriculum framework aims and delegates teaching lesson time to local authorities or schools (Eurydice, 2016).

In many European countries, including Albania, official minimum instruction time is shorter for the first and secondary grades (Eurydice, 2016; IZHA[1]2016). In the following grades, the number of classes increases steadily with a significant increase in lower secondary education. In some European countries retain the same allocation of instruction time in primary and in lower secondary education. In many European countries, including Albania classes are held five days a week (Eurydice, 2016; IZHA, 2016). In France classes are held four days a week, in Italy 6 days a week, in Germany are also held two Saturday per month. In many European countries' classes last from 40- 55 minutes, while in Albania it lasts 45 minutes. In some European countries the class varies even within an education system: (a) from 25 to 35 minutes in primary education, (b) from 35 to 45 minutes in lower secondary education, and (c) of 45- 60 minutes in upper secondary education (Eurydice, 2016; IZHA, 2016). Therefore,

[1] Albanian Institute for Development of Education

it is important to keep the balance between curriculum areas instruction time in different key stages. According to the authors' point of view, variabilities in classes instruction time even with an education system is an indicator of flexibility relating to different group ages of students and may also influence students' academic success.

Foreign languages in primary education in almost all European countries constitute less than 10% of teaching time. In some European countries, foreign languages constitute more than 18% of teaching time, that include 2- 3 languages. In most European countries at lower secondary education mathematics occupies 10 to 15% of teaching time. In some European countries, mathematics constitutes up to 20% of the instruction time (Eurydice, 2016). In many European countries, including Albania, the time spent on the natural sciences and social sciences in primary education vary from 9% to 15% (Eurydice, 2016; IZHA, 2016). In some European countries, the number of classes available to natural sciences constitutes the highest percentage in comparison to other areas (Eurydice, 2016). Variability between different education systems of foreign languages, mathematics, and science curriculum instruction time seems to be an indicator of different curriculum policies that reflect the priorities of different countries.

In many European countries, including Albania, physical education and arts occupy approximately 20% of total instruction time in primary education. The available time to the art curriculum area in lower secondary education is reduced in relation to the primary, remaining at no more than 10%. Some European countries gave more time to the arts curriculum field compared to other European countries (Eurydice, 2016; IZHA, 2016). ICT was developed as a course in many countries within a short time, as well to promote learning as cross-curriculum skill. Most of the European countries leave some flexible classes between subjects that schools can distribute between the core curriculum classes or develop cross-curricular activities, or others (Eurydice, 2016). In some European countries' schools are free to decide on the available time of the courses, throughout compulsory education. In most of the countries, students in lower secondary education are free to choose their courses up to a point, as optional core curriculum, giving the opportunity to choose their courses from a predetermined list (Eurydice, 2016; IZHA, 2016). Therefore, physical education, arts, and ICT curriculum instruction time are an important part of a student's education, although there are differences.

Instruction time distribution seems to be rooted in past and current student experience more than in their predictions for the future (Fernex, Lima, & Vries et al., 2015), on the time

dimension, extended instruction can occur within a school day or outside of it (Midkiff & Cohen-Vogel, 2015). Self-assured teachers view spent the most amount of time teaching, determined teachers view spent the most amount of time observing, and emerging teachers view spent the most amount of time in school (Krysher, Robinson & Edwards, 2015), in mathematics, as well as in English the average student received about 140 hours of instruction (Phelps, Corey, DeMonte, Harrison, & Loewenberg et al., 2012). So, instruction time allocation seems to be related to the student experience as well as to different categories of teachers.

2.3. Students 'school attitude

In the literature, the students 'school attitude is measured through the respective degrees of behavioural and recognition engagement. Students' school attitude has also been measured through corresponding degrees of behavioural and cognitive engagement. Although they do not use the term students' attitude towards the school, several studies focus on conceptual terms that relate and affect the student's relationship with the school (Libbey, 2004). The positive orientation toward school assessment was based on two dimensions: how much students like school and evaluated academic achievements (Jessor, Den Bos, Vanderryn, Costa, & Turbin et al., 1995), students with a positive orientation toward school think that academic achievement is relevant to their lives (Stern, 2012). There is a significant change in the attitude of secondary school students regarding gender and instruction time (Musheer, Govil, & Gupta, 2016), the female students' attitude is more positive than male students (Ozkan, 2013). Yurdabakan and Uzunkavak (2012) revealed that a significant difference does not exist between students' attitude when grade levels and participation assessment are considered. Therefore, students' school attitude is related to behavioural and cognitive engagement, gender, as well as to grade levels, and participation.

2.4. The relationship between curriculum instruction time and students' school attitude

Teacher knowledge did predict teachers' time allocation plans, particularly for teachers with relatively high knowledge (Spear-Swerling & Zibulsky, 2014), limited time, the mathematics teachers readiness and the perception of courses' importance, were found to be the most influential factors that management considers when assigning instruction time (Prendergast & O'Meara, 2016). Wilson, Denise, Gottfredson, & Najaka et al. (2001) established that students readily perceived and confirmed to the low expectations meted out by the teachers. Other

documented methods of studying external, systems-level factors influencing students' school attitude include measures of reportable behaviour such as the number of clubs attended by students (Voekl, 1996), or functional outcomes such as grades (McCoach, 2002). Indeed, the low-grade point average (GPA) has been shown in and of itself to be an excellent predictor of negative students' school attitude (Jessor et al., 1995). Jessor et al. (1995) research supports this finding and speculates that a low GPA indicates a detachment from school as well as an increased sense of helplessness regarding school. Studies show that, in fact, higher levels of commitment to activities that are non-academic such as sports, community service, and extracurricular activities are positively associated with higher school bond (Jenkins, 1997). So, students' school attitude is predicted by several variables, such as time allocation, students' expectations, levels of commitments in different activities, and especially students' grades.

A significant relationship at a low linear level was observed between the academic success of the students and their attitudes towards English language skills (Acar, 2016), students' attitudes toward school are strongly related to class disciplinary problems, teachers' treatment of students, and academic interests (Lai et al., 2015). Norton (2017) found that many students had disengaged from mathematical endeavour as a result of the overemphasis on mundane mathematics resulting in some students lacking the cognitive tools to engage with the concepts and having neither the intrinsic nor instrumental motivation to persist with secondary school esoteric mathematics. Instruction time is an important factor in student achievement (Haniger, 2016; Husted, 2016), and a key educational resource (Gromada & Shewbridge, 2016). But there is no association between the elementary school start time and middle school students' academic achievement (Dupuis, 2015), and working while in high school reduces the number of time students spend doing homework (Kalenkoski & Pabilonia, 2009). Quality of the classroom learning environment and time individual students spent in specific types of instruction interacted to predict students' comprehension (Connor et al., 2014), and teachers who were more aware of student-centred activities spent less time on teacher-centred activities (Kaya, Kablan, Akaydin, & Demir et al., 2015). Therefore, instruction time allocation influences several variables, such as students' school attitudes, student's engagement in learning, students' comprehension, as well as students' academic achievement.

Based on previous research it is evidenced a lack in investigating a specific relationship between curriculum instruction time and students' school attitude, therefore: *the main purpose*

of the study is to investigate the relationship between curriculum instruction time and student' school attitude

3. Methodology

3.1. Method

The quantitative approach was the main methodology used in the study supported by the qualitative approach. The review of official documentation and observation by self-reported instruments were the techniques used in the study. Secondary data for the instruction time variable were generated by Eurydice (2016), as well as by IZHA (2016). The qualitative approach, including a review of official documentation as well as interviewing, was used to support a quantitative approach in the study. Therefore, the explanatory mixed research design was used in the study.

The matrix for review of the official documentation, the structured questionnaires, and semi-structured interviews were the instruments used in the study. The matrix for the review of the official documentation, structured questionnaires as well as semi-structured interviews contains dimensions and statements that focus on instruction time according to curriculum areas and key stages in compulsory education in Albania and in European countries. The instruments are designed, piloted and used in the study by the researcher.

3.2. Sample and data collection

. The target population of the study is a population of lower secondary education schools selected to pilot competency-based curriculum. From the target population of schools, three samples were selected: (1) sample of students, (2) sample of teachers, and (3) sample of principals. Three selected samples were cluster samples, so the different respondents were selected by the same schools. The aim was to compare the data provided by students and by teachers for quantitative approach, as well as to compare the data provided by teachers and students or quantitative data, and data provided by principals or qualitative data. A random cluster sample of students (N= 398) and a random cluster sample of teachers (N= 105) of lower secondary education were selected to be used in the study to gather quantitative data. A breakdown of the random cluster sample of students included 222 females (55.8 per cent) and 176 males (44.2 per cent), while the teacher's sample was comprised of 78 females (74.3 per cent) and 27 males (25.7 per cent). A random cluster sample of principals (N=19) of lower

secondary education were selected to be used in the research to gather qualitative data. A breakdown of the random cluster sample of principals included 12 females (63.2%), and seven males (36.8%). Students, teachers, and principals were willing positively to answer the questions of the instruments.

3.3. Analysis

The findings of the instruments were summarized in a synthetic way to use as the basis for the analysis of the findings. A descriptive statistic, as well as a bivariate correlation statistic, were used for the processing of data collected by research instruments. The inductive open coding and the typology techniques were used to analyse the qualitative data. The research questions that investigate the relationship between instruction time and students' school attitude were answered tested using the Pearson product-moment correlation coefficient. Preliminary analyses and check of validity and reliability threatens performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity as well as to ensure the validity and reliability of qualitative results.

4. Results

4.1. Descriptive statistics

Curriculum instruction time includes the time that students spend in teaching in all courses included in the core curriculum or flexible core curriculum in a school or extra-curricular activity that is part of the official curriculum (Eurydice, 2012; Eurydice, 2013; Eurydice 2016).

4.2. Curriculum instruction time

The following are summary data of curriculum instruction time in compulsory education in Albania vs European countries of known- flexible, partly and flexible curriculum.

Table 1. Weekly instruction time in Albania vs European countries of non-flexible curriculum

No	Country	Key Stage 1	Key Stage 2	Key Stage 3	Key Stage 4	**Total- Teaching Hours per week**
		1st- 2nd grade	**3rd- 5th grade**	**6th- 7th grade**	**8th- 9th grade**	
1	Albania	40.50	73.50	56.00	67.50	237.50
2	Belgium –French Community	57.96	86.94	62.13	62.13	269.19
3	Belgium – German-speaking Community	57.96	86.94	62.13	66.30	273.35
4	Belgium – Flemish Community	56.74	85.11	60.97	65.20	268.03
5	Bulgaria	27.62	62.52	52.24	55.62	197.97
6	Denmark	44.04	79.16	57.12	63.50	243.82
7	Germany Grundschule + Gymnasium	39.46	77.97	65.48	62.57	245.50
8	Germany Grundschule + Hauptschule	39.46	72.20	46.22	42.34	200.22
9	Germany Grundschule + Realschule	39.46	77.97	61.62	69.31	248.36
10	Ireland	43.76	84.39	56.26	56.26	240.68
11	Greece	39.46	75.30	53.80	53.80	222.38
12	Spain	59.74	89.61	65.72	71.70	286.77
13	France	59.00	88.50	59.71	67.70	274.89
14	Italy	57.46	91.26	67.60	61.97	278.27
15	Cyprus	57.36	86.04	59.00	60.64	263.01
16	Latvia	36.49	63.81	50.39	54.14	204.84
17	Lithuania	36.15	65.95	58.54	59.47	220.13
18	Luxembourg	68.82	103.23	69.03	69.24	310.33
19	Hungary	37.08	60.26	44.04	48.68	190.05
20	Malta Primary + Secondary	60.22	87.61	55.52	53.54	256.86
21	Austria Volksschule + Allgemeinbildende Hörere Schule	45.06	75.80	61.46	64.52	246.83
22	Austria Volksschule + Hauptschule+ Polytechnische Schule	45.06	76.82	60.42	65.54	247.85
23	Portugal	61.46	95.57	71.90	83.88	312.79
24	Romania	39.40	70.86	57.08	58.07	225.42
25	Slovenia	43.73	75.79	57.83	59.74	237.10
26	Slovakia	43.33	75.07	55.86	55.86	230.10
27	Finland	38.86	66.78	51.14	59.23	216.00
28	United Kingdom – England	54.48	91.47	61.63	62.28	269.84
29	United Kingdom- Wales	54.48	91.47	62.92	64.86	273.73

30	United Kingdom – Northern Ireland	38.92	68.11	58.38	58.38	223.78
31	Liechtenstein Primary + Oberschule	48.96	87.90	67.94	66.91	271.72
32	Turkey	49.16	73.74	49.16	52.23	224.30
European Mean				247.55		

Source: (Eurydice,2016; IZHA,2016)

As shown in tables 1, there is a non-flexible curriculum in thirty- two other countries. There are 170 instructional days (35 weeks) per year in Albania compared to 185 days (38 weeks) that is European mean. Therefore, there is a difference of 15 instructional days (3 weeks) between Albania and European mean. In some European countries, there are 200 days (40 weeks) instruction a year; in some others, there are from 155 to 195 instructional days per year. There are 237.50 weekly instruction classes in Albania in grades 1- 9 compared to 247.55 that is European mean. Therefore, there is a difference of 10 weekly classes between Albania and European mean. 68.8% of the countries are between 185.59 weekly classes and 308.89 weekly classes (M=247.24; SD= 30.825). The minimum weekly classes are 190 and regard Hungary, and the maximum weekly classes are 313 and regard Portugal. Therefore, Albania has 47.5 more weekly classes than Hungary, and 75.5 less weekly classes than Portugal.

Table 2. Weekly instruction time in Albania vs European countries of partly and flexible curriculum

No	States\Grades	1	2	3	4	5	6	7	8	9	Mean
33	Czech Republic			3469				3578			240.58
34	Estonia	1785			2179			2520			221.36
35					7520					1205	297.87
36		7520								945	288.99
37	Netherlands Primary + *HAVO*				7520					1455.00	306.40
38	Netherlands Primary +*VMBO*	1856			2453			2728			240.24
39		6665									227.54
40	Netherlands Primary +*VWO*	Flexible									
41	Poland	3200				567			1974		195.99
42	Norway	1629				3537			1900		241.23

Source: (Eurydice,2016; IZHA,2016)

Flexible curriculum indicates instruction time allocated by the school and local authorities. As shown in table 2, there is a ½ flexible curriculum in seven countries, and a flexible curriculum in three countries.

The following are data of curriculum instruction time in Albania and in European countries according to the curriculum areas and key stages.

Table 3. Weekly instruction time according to curriculum areas and key stages in Albania vs European countries

		Key Stage 1		Key Stage 2		Key Stage 3		Key Stage 4		**Total Freq.**	
No	**Curriculum areas**	**1st- 2nd grade**		**3rd- 5th grade**		**6th- 7th grade**		**8th- 9th grade**			
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
1	Literacy and foreign languages learning Albania	16.00	39.60	25.00	34.10	16.00	28.60	16.00	25.80	73.00	30.74
1.1	Literacy and foreign languages learning European Mean	18.40	28.09	26.12	25.13	15.33	21.16	14.18	18.92	74.05	29.91
2	Mathematics Albania	8.00	19.80	12.00	16.30	8.00	14.30	8.00	12.90	36.00	15.16
2.1	Mathematics European Mean	8.90	13.59	13.43	12.92	8.19	11.30	7.61	10.15	38.14	15.41
3	Natural sciences Albania	2.00	4.90	5.00	6.80	6.00	10.70	12.00	19.30	25.00	10.53
3.1	Natural sciences European Mean	3.75	4.85	7.21	6.85	6.32	8.53	9.99	11.99	27.27	11.02
4	Social studies Albania	2.00	4.90	5.00	6.80	8.00	14.30	10.00	16.10	25.00	10.53
4.1	Social studies European Mean	1.96	2.99	5.37	5.17	6.11	8.43	6.97	9.30	20.41	8.24
5	Physical education Albania	6.00	14.80	9.00	12.20	6.00	10.70	9.00	9.70	30.00	12.63
5.1	Physical education European Mean	4.71	7.19	7.22	6.94	4.82	6.65	4.13	5.51	20.89	8.44
6	Arts education Albania	4.50	11.10	7.50	10.20	5.00	8.90	4.00	6.50	21.00	8.84
6.1	Arts education European Mean	5.11	7.80	8.18	7.87	5.09	7.02	4.09	5.46	22.48	9.08
7	Technology and ICT Albania	0.00	0.00	4.00	5.40	3.00	5.40	2.00	3.20	9.00	3.79
7.1	Technology and ICT European Mean	1.09	1.66	3.21	3.09	4.06	5.60	3.48	4.64	11.83	4.78
8	Optional curriculum Albania	2.00	4.90	6.00	8.20	4.00	7.10	6.50	6.50	18.50	7.79
8.1	Optional curriculum European Mean	2.87	4.08	3.98	3.83	4.92	4.54	8.84	10.46	20.61	8.33
9	Total Albania	40.50	100.00	73.50	100.00	56.00	100.00	67.50	100.00	237.50	100.00
9.1	Total European Mean	47.88	100.00	77.96	100.00	58.90	100.00	62.77	100.00	247.55	100.00

Source: (Eurydice,2016; IZHA,2016)

As shown in table 3, there are small differences between Albania and European mean of different curriculum areas 'weekly instruction time, although there are differences through key stages. 30.74% of the weekly instruction time is allocated for literacy and foreign

languages in grades 1-9 in Albania compared to 29.91% that is European mean. 15.16% is allocated for mathematics in Albania compared to 15.41% that is European mean. There are no differences in natural sciences, social studies, arts, technology and optional curriculum in Albania compared to European mean. Therefore, there is a little difference in weekly instruction time on curriculum areas between Albania and European mean.

4.3. Students' school attitude

Table 4. Frequency values of students' school attitude

Students' school attitude

		Students		**Teachers**	
		Frequency	Per cent	Frequency	Per cent
		Students		**Teachers**	
N	Valid		398		105
	missing		0		0
	very dissatisfied	47	11.81	8	7.62
	moderately dissatisfied	69	17.34	15	14.29
	slightly dissatisfied	89	22.36	19	18.10
	slightly satisfied	88	22.11	21	20.00
	moderately satisfied	76	19.10	26	24.76
	very satisfied	29	7.29	16	15.24
	Total	398	100.0	105	100.0

As shown in table 4, there are 4.19% more students than teachers very dissatisfied, 3.05% more students than teachers moderately dissatisfied, 4.26% more students than teachers slightly dissatisfied on students' school attitude. There are 2.11% more students than teachers slightly satisfied, 5.66% more teachers than students moderately satisfied, 7.95% more teachers than students very satisfied with the students' school attitude. Considering three levels indicates that 29.15% of students and 21.91% of teachers claimed low level, 44.47% of students, and 38.1% of teachers claimed medium level, 26.39% of students, and 40% of teachers claimed a high level of students' school attitude. The differences between students

and teachers' perceptions, especially in low and high levels of students' school attitude indicate that there is not a required positive students' school attitude.

4.4. Inferential statistics

Research question: Is there a significant correlation between annual instruction days and students' school attitude?

Table 5. Pearson correlation outputs between annual instruction days and students' school attitude

Correlations

		Students		**Teachers**	
		Students' school attitude	Annual instruction days	Students' school attitude	Annual instruction days
Students' school attitude	Pearson Correlation	**1**	**-.307**	**1**	**-.236**
	Sig. (2-tailed)		**.002**		**.004**
	N	**398**	**398**	**105**	**105**
Annual instruction days	Pearson Correlation	**-.307**	**1**	**-.236**	**1**
	Sig. (2-tailed)	**.002**		**.004**	
	N	**398**	**398**	**105**	**105**

The Likert scale questionnaire was used to measure the students' school attitude by students and teachers. As shown in table 5 there is a low, negative correlation between annual instruction days and students' school attitude, $r = -.307$, $n = 398$, $p < .005$ according to students, as well as according to teachers, $r = -.236$, $n = 105$, $p < .005$, with high levels of annual instruction days associated with lower levels of students' school attitude. The value of correlation means that increasing annual instruction days values would result in decreasing of students' school attitude values, although there are small but not significant differences between students and teachers' perceptions. The result was consistent with previously reported work by (Jessor et al., 1995; Wilson et al., 2001; Voekl, 1996; McCoach, 2002). In conclusion, *there is not a significant correlation between annual instruction days and students' school attitude.*

Research question: Is there a significant correlation between week instruction days and students' school attitude?

Table 6. Pearson correlation outputs between weekly instruction classes and students' school attitude

Correlations

		Students		**Teachers**	
		Students' school attitude	Weekly instruction classes	Students' school attitude	Weekly instruction classes
Students' school attitude	Pearson Correlation	**1**	**.231**	**1**	**.331**
	Sig. (2-tailed)		**.000**		**.001**
	N	**398**	**398**	**105**	**105**
Weekly instruction classes	Pearson Correlation	**.231**	**1**	**.331**	**1**
	Sig. (2-tailed)	**.000**		**.001**	
	N	**398**	**398**	**105**	**105**

As shown in table 6 there is a low, positive correlation between weekly instruction classes and students' school attitude, $r = .231$, $n = 398$, $p < .005$ according to students, as well as according to teachers, $r = .331$, $n = 105$, $p < .005$, with high levels of weekly instruction classes associated with high levels of students' school attitude. The value of correlation means that increasing week instruction classes' values would result in increasing of student's school attitude values, although there are small but not significant differences between students and teachers' perceptions. The result was consistent with previously reported work by (Gromada & Shewbridge, 2016; Kalenkoski & Pabilonia, 2009). In conclusion, *there is a significant correlation between weekly instruction classes and students' school attitude*.

Research question: Is there a significant correlation between classes' instruction minutes and students' school attitude?

Table 7. Pearson correlation outputs between classes' instruction minutes and students' school attitude

Correlations

		Students		**Teachers**	
		Students' school attitude	Classes instruction minutes	Students' school attitude	Classes instruction minutes
Students' school attitude	Pearson Correlation	**1**	**.337**	**1**	**.445**
	Sig. (2-tailed)		**.001**		**.004**
	N	**398**	**398**	**105**	**105**
Classes instruction minutes	Pearson Correlation	**.337**	**1**	**.445**	**1**
	Sig. (2-tailed)	**.001**		**.004**	
	N	**398**	**398**	**105**	**105**

As shown in table 7 there is a medium, positive correlation between classes instruction minutes and students' school attitude, $r = .337$, $n = 398$, $p < .005$ according to students, as well as according to teachers, $r = .445$, $n = 105$, $p < .005$ with high levels of classes instruction minutes associated with high levels of positive students' school attitude. The value of correlation means that increasing of classes' instruction minute's values would result in increasing of students' school attitude values, although there are small but not significant differences between students and teachers' perceptions. The result was consistent with previously reported works (Jenkins, 1997; Acar, 2016; Haniger, 2016; Husted, 2016). In conclusion, *there is a significant correlation between classes' instruction minutes and students' school attitude*.

5. Results of interviews

Almost all the principals (92.78%) claimed that instruction time is almost enough to address the aims and objectives of the competency-based curriculum, although there are differences to European countries. Meanwhile, nearly all the principals (89.97%) claimed that there is a positive students' school attitude; meanwhile, there are sporadic negative attitudes shown by students. More than two-thirds of principals (76,35%) indicate that the instruction time planned for natural sciences may contain more classes available after the concepts of this field require more work by teachers and students to be learned. One of the principals that teaches science at school pointed out that: "Natural sciences contain more difficult terms or concepts compared to social sciences, humanities, etc. We, as teachers of this field, do not have much time to explain clearly, and in more details these concepts. We need more classes to use, especially for laboratory work, such as experiments, surveys, etc.".

Around two- thirds of respondents claimed that physical education might include fewer hours at their disposal and might support more with sports areas and necessary didactics. One of the principals emphasized that "There is a very little sport area at my school. At the same time, there is an increase in physical education classes. Where can teachers of physical education spend their classes at these conditions? Therefore, the educational institution should think about sports areas as well as about other equipment to support physical education". However, the principals pointed out that there is a negative relationship between annual instruction days and students' school attitude, but there is a positive relationship between week and classes' instruction time and students' school attitude. Therefore, qualitative results support quantitative outputs.

6. Conclusions and implications

One main limitation of the study as part of the conclusions is that the study does not include the influence of teaching or other variables on students' school attitude. The aim of this study was to investigate the relationships between curriculum instruction time and positive student's school attitude. The prior assumption was that the curriculum instruction time influence on students' school attitude.

The results showed that there are differences of annual, weekly, days, and classes instruction time between European countries and Albania. This conclusion is supported by prior research. Therefore, in many European countries, the minimum instruction time is shorter for the first

and secondary grades, meanwhile, in the following grades, the number of classes increases steadily (Eurydice, 2016; IZHA, 2016). In many countries also, classes are held five days a week, and classes last from 40- 55 minutes (Eurydice, 2016; IZHA, 2016). Therefore, Albanian education institutions should consider decreasing the difference between annual, weekly, and classes time similarly to the most European education systems. There are little differences in literacy and foreign languages, as well as in mathematics, natural and social sciences, arts, technology, and optional curriculum on annual and weekly instruction time between Albania and European mean. This conclusion is consistent with previous work. Therefore, in some European countries, foreign languages constitute more than 18% of teaching time, mathematics constitutes up to 20%, the natural and social sciences vary from 9% to 15% (Eurydice, 2016; IZHA, 2016). Therefore, the educational institutions should keep the balance between curriculum areas instruction time in different key stages. Thus, Albanian institutions of education should consider decreasing the difference in the distribution of annual and weekly instruction time in these curriculum areas in Albania compared to most European education systems.

The results showed that there is a relatively non-required students' school attitude in lower secondary education. Therefore teacher, principals, as well as educational institutions, should consider addressing students' school attitude to influence students' motivation and self-interest. The study confirmed that annual instruction days influence negatively on students' school attitude. Meanwhile, the study results noted that week instruction days and classes instruction minutes influence positively on students' school attitude. This conclusion is supported by other research. Therefore, there is a significant change in the attitude of school students regarding instruction time (Musheer, Govil, & Gupta, 2016). Instruction time is an important factor in student achievement (Haniger, 2016; Husted, 2016), and a key educational resource (Gromada & Shewbridge, 2016). Quality of the classroom learning environment and time individual students spent in specific types of instruction interacted to predict students' comprehension (Connor et al., 2014). Therefore, Albanian education institutions should consider reducing annual instruction days to influence students' motivation and interest.

The results of this study supported by other researchers about the importance of curriculum instruction time have important implications for future research. Such research should investigate different school variables and their relation to curriculum instruction time and to students' school attitude. The results of the study also have important implications for

practice. Significant interventions in curriculum design, as well as in students' school attitude, should be designed and developed to support students' school attitude.

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Changing reading habits and methodological options resulting from digital transformation

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Abstract

The love of reading is an indispensable condition for the cultural development of nations. Children's habits when gaining information have changed, which has affected their relationship to reading, thus it is important to search for such solutions and supporting systems which enhance the popularisation of reading, and which support the interpretation of the content read. The paper presents such digital applications suitable for sharing the reading experience that can be used not only within the frames of formal classes, but in non-formal education as well. Libraries can motivate students with the applications, and by utilising the new possibilities, students will be more open to acquire knowledge and they will be more ambitious to experience reading. The article analyse which is the most innovative option: a share interface created with the intention of self-study, or the institutional initiatives to analyse a particular work of literature? Shall we encourage students to write blogs, or should they capture a particular moment of the work in a computerised graphic format? Will an analysis in a tag cloud shed light onto the most important elements, or should the experience be conveyed through moving pictures? The paper presents concrete feasibility options and analyse them based on their practical benefits.

Keywords: ICT innovation; ICT innovation in libraries; non-formal learning; popularising reading; reading experience; methodology

1. Introduction

The economic crisis of 2008 required a reconsideration of factors related to the functioning of society. The European Union considers the increasing of the capacity of human capital as one of the most important tools of dealing with the crisis. Consequently, the upcoming generations should be enabled to take advantage of the latest technologies via the creation of the necessary instructional and informal environment.

2. Digital literacy

Digital culture is gaining an increasing prevalence these days. Libraries have to be prepared to meet the needs of digitally literate readers while presenting special methodological approaches and options for librarians. The development of ICT devices impacts learning habits, making the respective qualification and preparation level of pedagogues and librarians crucially important.

2.1. Definition of digital natives

First we provide a list of conditions the current youth generation has to meet in order to be declared digital natives:

- an ability to use on-line information and communication technologies in a natural and problem free manner.
- proficiency in using search engines, search fields (Amazon, Google) providing fast gratification
- the belief in the importance of the incorporation of data bases in a virtual learning environment,(VLE) or in the actual working site
- favouring cooperation, teamwork, and social networks.
- non-linear, hypertextual thinking, reading is performed by mostly scanning via links
- multitasking as second nature (simultaneous performance of several tasks, living with a continuous yet partial attention or concentration span) (Godwin & Parker, 2008)
- a belief in the veracity of any information published on the web.
- working with micro contents (blog entries, posts, tweets) to convey thoughts.
- an ability to copy, paste and share desired content. (Racsko, 2012)

2.2. Digital literacy surveys

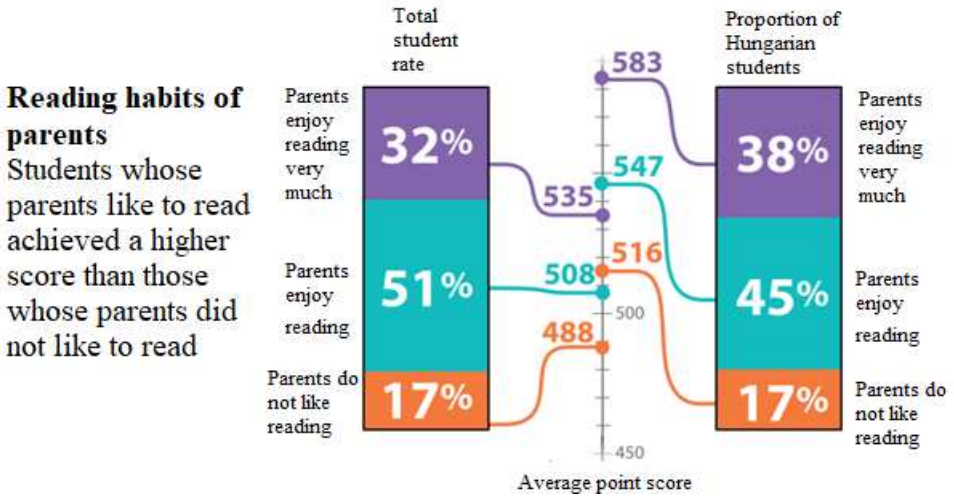
The respective study has a wide focus, which proves a partial explanation for the relative lack of results. In 2006 as part of the international PISA (Programme for International Student Assessment) survey in three countries digital assessment methods were introduced as an experiment. The first digitally tested aptitude and skill was in the area of natural sciences. However, by 2009 19 countries measured reading skills of on-line texts and in 2012 in addition to digital reading comprehension, the mathematical skills were assessed in a virtual form on a computer in 32 countries.

1. Figure Countries participating in the PISA survey(Balázsi, Ostorics, Szalay, Szepesi, & Vadász, 2013)

The results of the 2012 PISA survey suggest that students cannot acquire the adequate digital competences. However, the results widely vary according to countries as students from the Far East, from Anglo-Saxon countries and Estonia achieved above average scores, while in Italy, Germany, Portugal, and in Scandinavia average performance was registered. (Balázsi et al., 2013)

The performance of Hungarian students in the comprehension of digital texts was rather disappointing in 2015. As the respective tasks were placed at the final section of the test, 30% of Hungarian students did not even attempt to solve them. (STEKLÁCS, 2018)

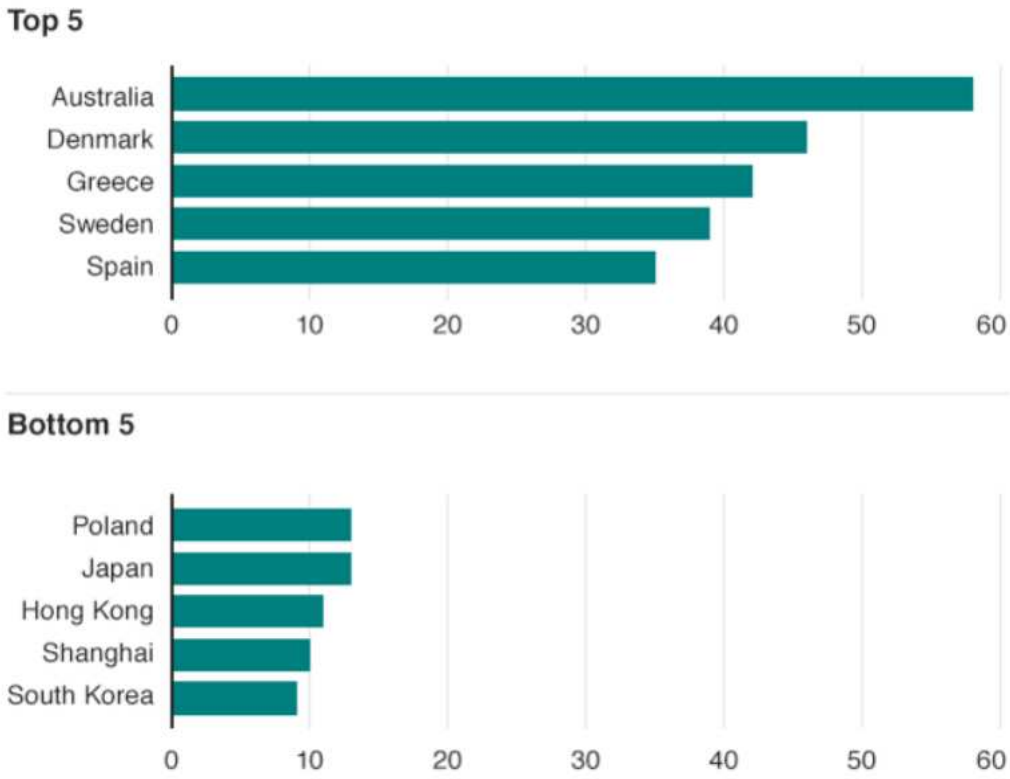
The situation is all the more distressing as Hungary in a PIRSL survey assessing the reading comprehension of fourth grade students was ranked 20th among 45 countries with a score of 39 points higher than the average score of 500 in 2011. Furthermore, in 2016 an even more significant improvement was achieved as Hungary was placed 13th among 50 countries with a score surpassing the average score of 500 with 54 points. ((A brief summary of the 2011, 2016 PIRLS and TIMSS surveys and the respective results, 2016.) Subsequent analyses suggested that "students whose parents liked to read could achieve better results than those whose parents did not prefer reading."(Info-graphics of a student background survey)



2. Figure Correlation between reading habits of students and their parents

Moreover, a 2018 survey assessing the digital competence of teachers identified information search and retrieval as the weakest competence of pedagogues. (ESZENYINÉ, 2018) The overall conclusion stated that pedagogues and the total public education sphere should be provided support in the fields of digital literacy, competence development and several related areas. for the implementation of curricular objectives. (ESZENYINÉ, 2018)

The elaboration of digital literacy does not require the substitution of textbooks for computers. It was concluded that those students had the highest performance in the PISA digital literacy testing, who used the computer frequently, but for a short time. An analysis published on the BBC website demonstrates that 8-12 minute computer use is sufficient to achieve outstanding results.



3. Figure Average daily minutes using internet at school (Coughlan)

The fact that those countries, where the Internet use is very intensive did not perform as well on the tests proves that Internet use by itself does not guarantee productivity. Consequently, the need emerges for the elaboration of methodological approaches usable during the specific classes and within informal learning contexts, in addition to their combination with traditional instruction as well.

It is an added difficulty that both teachers and librarians are required to develop the digital literacy of students, while their own skills need improvement as well. The Digital Agenda of the European Union assigns priority to digital literacy during its operational span lasting until 2020. Consequently, governments of member states are required to improve the digital skills as a means of promoting social and economic development. The info-communication strategy of Hungary aims at reducing digital illiteracy below 40% in the 2014-2020 period. This task should be fulfilled by cultural and community institutions. ”A crucial requirement for the development of the digital competences of people and small enterprises is the high level of digital familiarity of pedagogues and trainers participating in public and adult education along with the proficiency of public servants and administrators in the use of electronic public administration and other services. Consequently, the improvement of the digital competences

of these two groups is essential as well." (*Nemzeti infokommunikációs stratégia (National info-communication strategy) 2014-2020*)

Libraries also have to contribute to the formation of digital competences. One such method could be the establishment of a national network of training and consultation programs in larger cities both aimed at the business sphere and the general population regarding the electronic administration options.

Such new concepts appeared as e-Inclusion referring in a narrower sense to limiting the digital exclusion due to a lack of digital competence or Internet access. In a broader sense e-Inclusion aims at providing equal digital opportunities to the socially disadvantaged and disabled via the elimination of obstacles (*Nemzeti infokommunikációs stratégia (National info-communication strategy) 2014-2020*) related to physical mobility and spatial distance. The implementation of e-Inclusion plans will be among the new responsibilities of libraries.

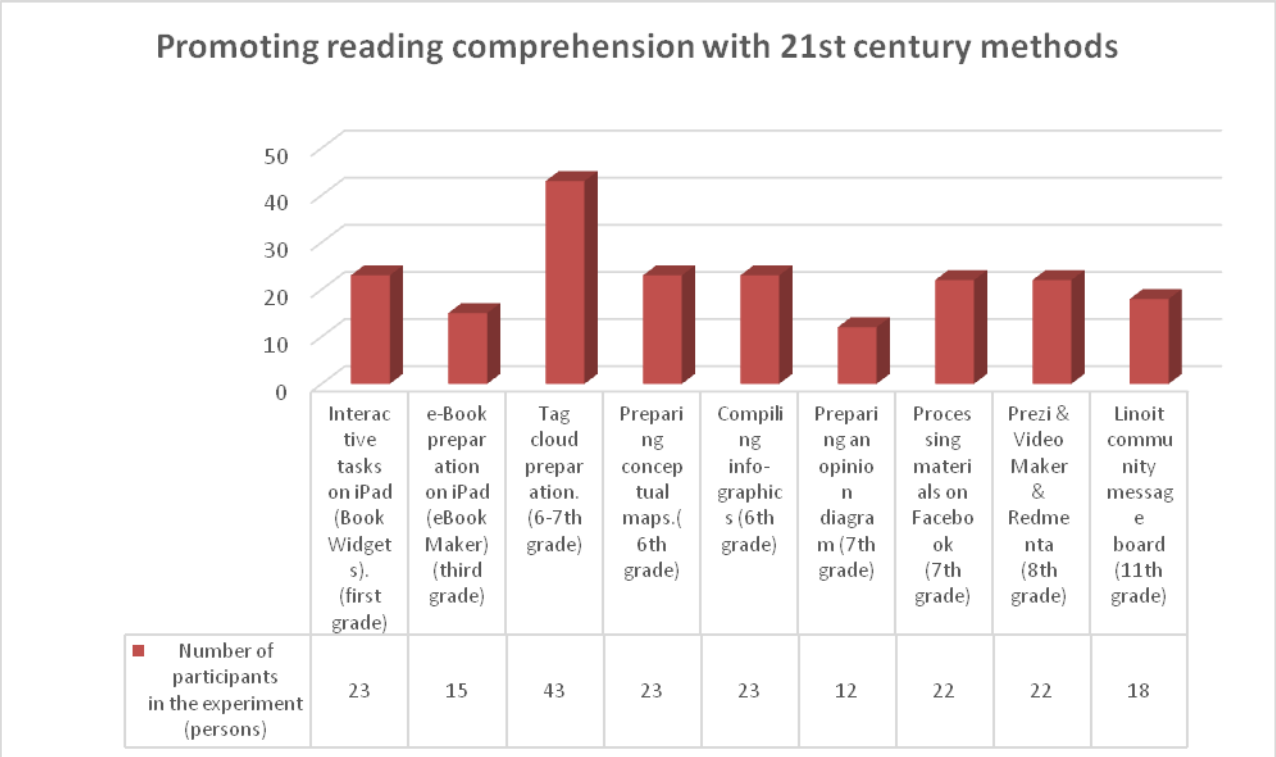
It is important to clarify that the concept of digital literacy does not exclusively refer to the use of info-communication devices. **Digital literacy can be defined as a conscious use of digital sources via a familiarity with info-communication devices, along with a communication and media production activity.** Thus the goal of any developmental effort has to surpass the mere use of devices and such solutions have to be elaborated whose application can increase the digital literacy of participants during the instruction and reading process unwittingly.

3. Methodological options

The love of reading is indispensable for the cultural development of nations. Since the modified information acquisition habits of students have an impact on their attitude to reading, it is important to find such solutions or support systems, which help the popularization of reading and the interpretation of the read material. If such methods are chosen which promote the discussion and analysis of the given text via ICT devices, students' digital literacy is developed at the same time.

The methods listed below were applied during the reading of various texts. Our experiment included 201 students. The members of the sample attending the lower elementary grades worked with folk or fairy tales, students in the upper section read texts related to Biology lessons, and fifth grade students focused on Géza Gárdonyi's novel, Eclipse of the Crescent

Moon.



4. Figure Promoting reading comprehension with 21st century methods

In the next stage of the research process the respective methods were tested in a library environment and students focused on the data visualisation aspects of a youth novel (Laura Leiner's Joan of Arc High School).

According to the respective results the following approaches promised the highest potential:

3.1. Tag cloud

Tag clouds containing the crucial informative words and expressions of the given document are effective visual means of presentation. The size, thickness, and dominance of the given words refer to relevance and frequency of use in the respective texts.

5. Figure Tag clouds made with the application of Tagxedo.

Application options

- Visualization of the content of the text found on a web page, or of the expression of the frequency of words searched for by users
- In case of the alphabetical arrangement of key terms the relevance is expressed by the letter size (font) or colour
- Facilitating navigation on a webpage where tags are functioning as references to subpages.

The tag cloud can be ideal for the illustration of the most frequently occurring words in a given text and the expression of the frequency of certain expressions.

We distinguish three types of tag clouds: (Tarcsi, Abonyi-Tóth, & Horváth)

- Text cloud. A tag cloud made from the words of a given text, the size of the expressions or words is determined by the frequency of occurrence.
- Collocational cloud: This is a version of a tag cloud illustrating the verbal collocations of the whole text, the size expresses the connection with the desired key term.
- Data cloud: The size of the tag is determined not by the frequency of occurrence, as it indicates a given quantity or value, i.e. the description of stock values.

The most frequently used on-line or web-based tag cloud producing applications include the Wordle, TAGul, TagCrow, Tagxedo

Tag clouds can be used for the processing, discussion, or analysis of readings.

The simplest solution is copying the electronic text of the given reading material into the tag cloud generating application and following a few format adjustments we download the respective info-graphic.

While this solution is fast and in most cases produces spectacular results, it is not suitable for the preparation of a tag cloud supplementing the reading journal. A reading experience is totally subjective and it cannot be described by a simple visually coded word frequency index. One of the reasons is that the words of the texts do not necessarily convey the message or the

respective impact on the reader, and the other one is the greater frequency of articles, conjunctions, demonstrative terms, and general expressions as compared to that of the relevant textual components.

Tag clouds with real education value and relevance to the given reading can be prepared not by the raw texts, but the word lists or vocabulary lists made by the user and the respective relevance index reflecting the subjective judgment of the reader. This method is ideal for natural science texts requiring the students to highlight the most important points and to visualize their findings.

Other features of suitable software include the ergonomic aspects of the operational surface, the info-graphic formation options and the usability of the given tag cloud.

It provides a competitive edge if the application includes opportunities for the setting of the colours and fonts of the given words along with the respective hyperlinks. The interactive aspects can be intensified if the user can set the outline of the total cloud.

Learners have to present the completed graphic image or provide access to it. The picture of the word cloud should be downloadable and a link facilitating graphic presentation along with an embed code should be available as well.

3.2. Info-graphics

Info-graphics originates from the field of applied graphics and entails the simultaneous application of drawing, photographs, and text. The purpose of info-graphics is the communication of information and it is more than a photograph or a written text on its own. Good infographics can draw attention, provides information, and is easily understandable, at the same time it is more complex than a drawing, and much more informative. (ISOTYPE: International System of Typographic Picture Education)

Info-graphics could be static, in which case a picture contains all the information, but there are interactive info-graphics facilitating the breakdown of the pictures to further info-graphic presentations in order to achieve more detailed information.

6. Figure Info-graphics prepared by a 7th grade student on the Eclipse of the Crescent Moon

While its most important objective is the communication of information, info-graphics due to a visual presentation and capacity of highlighting details from a vast amount of data can carry messages and direct viewer attention to the essential information with artistic quality graphic solutions.

Info-graphics can not only be useful in newspapers, but can help the teaching process as well. An ideal project task would be for students to prepare their own info-graphics. While it appears to be easy, the fulfilment of the given task requires good eyes and reliable computer programs as well. There are certain webpages exclusively made for facilitating the preparation of info-graphics. One such program is the Visme (https://www.visme.co/). By the help of the pre-arranged patterns of this program sophisticated info-graphics and presentations can be compiled. The program is free of charge.

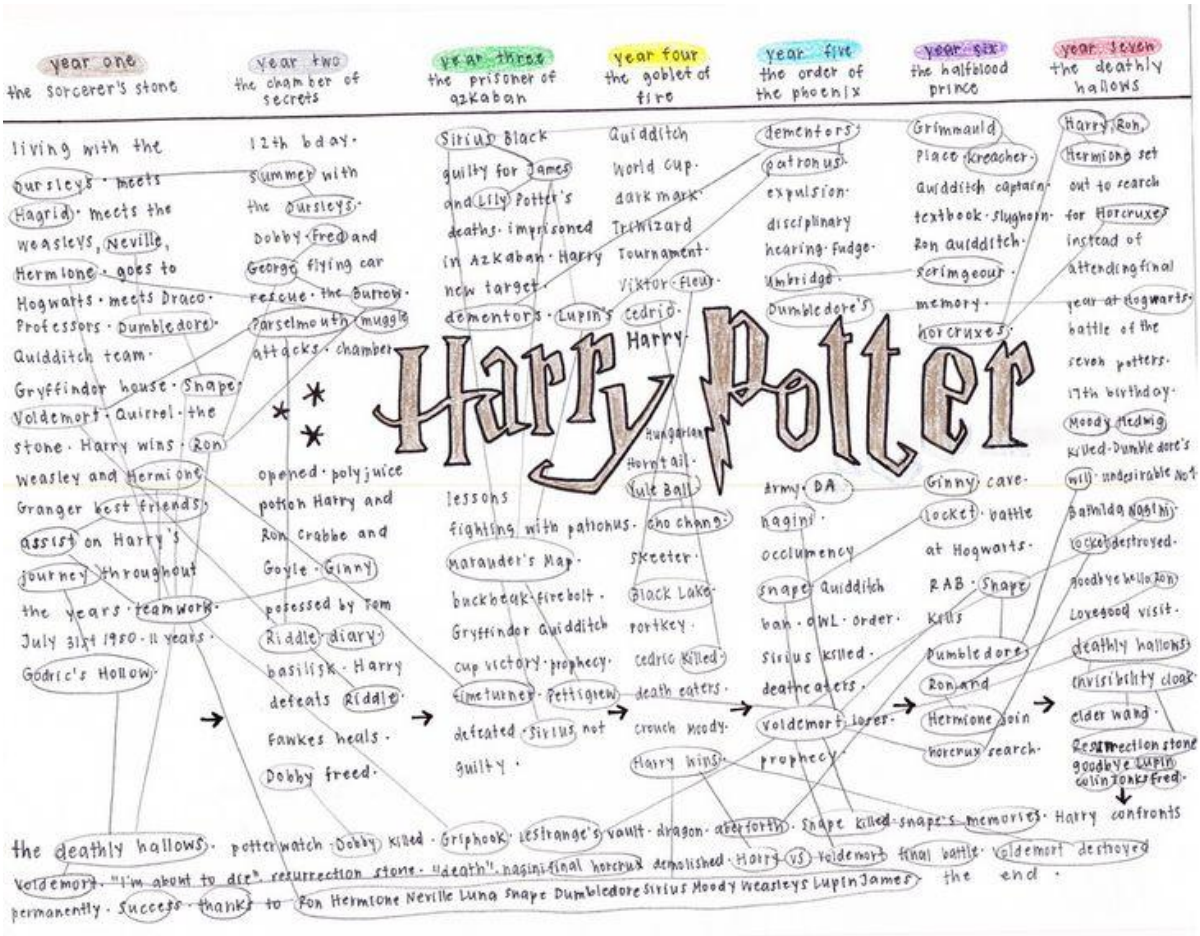
7. Figure Info-graphics on Harry Potter

3.2.1. Conceptual map

Conceptual maps express a connection between the most frequently used concepts and phenomena in the given text. Conceptual maps are used for the description of specific professional fields. The presentation of information is helped by visual images depicting the relation, hierarchical position, and connection of concepts.

Conceptual maps describing completed conceptual networks by utilizing the options provided by ICT are suitable for the illustration of the messages of ideas, books, or films.

Conceptual maps follow a certain layout as the title of the given topic is centrally positioned and the respective themes are branching out. First the main menu points, later the sub points are shown. Conceptual maps can be edited jointly and the shared picture can be exported. Certain conceptual map making programs, such as Mindomo (www.mindomo.com) integrate external links and multimedia content as well. While at the beginning they are cost free, after a certain time or duration of use such services will only be available after paying a charge.



8. Figure The conceptual map of the Harry Potter series ("The conceptual map of the Harry Potter series,")

Conceptual maps are excellent for the processing of reading experiences. The conceptual map production applications are ideal to create the results of shared work efforts. There are many simple and easy to use software including Text2mindap (tobloef.com/text2mindmap), bubbl.us (bubbl.us), mindmeister (www.mindmeister.com), mindomo.com (www.mindomo.com).

9. Figure Conceptual map prepared by a 6th grade student to the Eclipse of the Crescent Moon

3.3 Digital story telling with motion picture

One of the creative methods of processing reading experiences is the use of programs facilitating digital story telling. Such programs can be used to sequence still images or motion picture slides on demand thereby facilitating the recall or retrieval of the narrated story. Crucial features include simple use, the option of the inclusion of user comments, and recording the story telling process without external devices. The respective applications provide the following options:

- Establishing the sequential order of stills and motion picture images prepared by the instructor on demand.

10. Figure Animoto Video Maker

One such suitable software is the Animoto Video Maker. The easy to use program allows the integration of photographs and motion picture images into a video. Certain preparations, however, have to be made before using the program. First a media collection or repository has to be established. The collection must include still and moving images related to the readings of the students. The stills can take the form of photorealistic images, but teachers can include illustrations from the given book. Motion picture elements can describe scenes acted out by the teacher or students. The videos should be very short, only a few seconds (the exact rendition of the plot is not a principal priority) and dialogues should only be included if it is inevitable. In order to enable students to comment on the events, dialogues should be avoided.

The program can be used on several levels. First only still images should be made. In this case the sequential ordering of the pictures is sufficient. After becoming proficient users motion pictures complemented with the narration of students or music can be prepared.

This type of storytelling can be carried out on personal computers, as the Movie Maker Live Program can be used in a Windows environment, and the iMovie can function under the OS X operation system. Both software are free and part of the operation system.

- Establishing the sequence of stills, motion picture images, and animations on demand.

11. Figure The My Story-Storybook and e-Book Maker for Kids by Teachers ("My story app,")

The My Story-Storybook and e-Book Maker for Kids by Teachers is also easy to use. The program facilitates the compilation of stories whose components are selected form pre-arranged repository of media elements. Additional features include the recording of sound and the export of the completed works in the e-Pub format.

4 Summary

Digital options for the sharing of reading experiences can not only be used during lessons, but in the non-formal education sphere as well. Libraries can increase the activity of students whose familiarity with the info-communication technologies makes them more willing to learn or start reading. These methods increase the significance of libraries along with motivating students and developing their digital literacy.

Acknowledgement

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Analysis of students' dropout rate at Subotica Tech

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Abstract

The analysis of the study success at the Subotica Tech - College of Applied Sciences (Serbia) was done with the aim of determining the passing of exams success and the completion of the studies in order to determine the dynamics of the study and to detect the critical points of the teaching process which lead to problems and finding the best way to eliminate them. Indicators, which were used, are the passing of students at the end of the fall semester, as well as the correlation of success from high school achieved by the enrolled students, with success in the entrance exam and success after the first year of studying.

Keywords: dropout rates; higher education; engineering studies,

1. Introduction

Academic failures among university students have been the subject of interest in higher education community (Namestovski, et al., 2018). The definition of dropping out is complex, as there are different definitions perhaps the most common being its consideration as transferring to a different course and/or university (Heublein, 2014), or alternatively definitively dropping out of university, identified as non-enrolment on the original courses in the two years after the last enrolment (Gury, 2011).

According to Times Higher Education (Times Higher Education, 2018), one in four UK student nurses drops out of degree courses, in USA more than 48 % of first-time, full-time students who started at a four-year college had not earned a degree (Hess, 2018). That is why student retention is an increasing concern for higher education institutions. According to the Higher Education Development Strategy in the Republic of Serbia (MPNTR, 2012), in the section "The Vision for the Development of Academic Studies", it is defined that the efficiency of studies should be such that more than 15% of students do not leave studies. The current state of academic studies in Serbia is such that the degree of dropout ranged from 43% to 24% (with a downward trend) from year 2000 to 2004.

A great number of studies managed to prove that the increase of absenteeism will by and large lead to a decrease in grades. A strong correlation between lecture attendance and examination performance by also presented by Purcell in his study (Purcell, 2007). For every 10% increase in student attendance at lectures, there was a 3% enhancement in examination performance (Molnár & Sik, 2018) and (Kővári, 2019).

2. Review of Literature

Many interested parties' debate and try to find reasons for students' dropout. Consequently, the ability to predict a student's performance could be useful in many ways to stakeholders of higher education institutions. According to (Sagenmüller, 2017), there are eight reasons why students drop out from higher education:

- financial problems;
- poor secondary school preparation;
- the student is not sure or convinced with the major;
- conflict with work and family commitments;
- increasingly failing courses;
- lack of quality time with teachers and counsellors;
- de-motivating school environment and
- lack of student support.

Dropping out of school is a global issue in the world and many studies on dropout have examined factors contributing to the dropout of student. While some factors exhibit constant effects, like high school characteristics, other effects do vary from the first year to the fourth. Men and women do not generally exhibit the same dropout behaviour. Socio-economic background, and especially the parents' level of education, would appear to be influential only at the beginning of the university period (Gury, 2011).

Students' prior academic histories are also important when we talk about dropout. Older students who did not enter higher education upon completing secondary education are subsequently more likely to fail or drop out (Tinto, 2010).

Researchers from the University of Granada have created a statistical model that evaluates the likelihood that the student will drop out of studies. The purpose of the research is to solve the problem of giving up because 30-50% of students in Spain dropout at some point of studies. The model analyses students' databases from 1992 to the present, using the logistic regression

model, which allows calculating the likelihood of dropping out of studies. More than 10,000 students of computer science, about 25,000 students of economics and about 40,000 students from the philosophy and arts have been analysed. The rate of dropout by computer science and economics students is about 40%, while for students of philosophy and arts is more than 60%. The results showed that those who score low on the entrance exam (had a low number of points), as well as those who enrolled at the age of 25 or more, drops out mostly. The impact of the family also proved to be an important factor in leaving the studies because students could not cope with the pressure of their parents. This research shows that out of 23 variables that were studied, performance and average grade are most related to dropout. The lower the grades are, the greater the likelihood that the student will dropout is, while the sex and the geographical background have almost no influence (Rovira, Puertas, & Igual, 2017).

3. Research

Based on the findings of researchers in Granada (Rovira, Puertas, & Igual, 2017), we conducted a research at the Subotica Tech- College of Applied Sciences (Serbia). The participants were the students who enrolled for the first time in the 2018/19 school year (changes from one study program to another were not taken into account as well as students who redid their first year of study).

Table 1 gives an overview of the number of students who enrolled the Subotica Tech and who have certified the fall and summer semester of the respective school year. On the basis of the data presented in the Table 1, on average, 76% of students certified the fall semester and 61% the summer semester, so the dropout rate is nearly 40%.

Table 1. Dropout rate

Year	Number of students	% of students who certified the fall semester	% of dropout	% of students who certified the summer semester	% of dropout
2012/13	223	80	20	64	36
2013/14	218	77	23	61	39
2014/15	165	73	27	57	43
2015/16	161	73	27	54	46
2016/17	162	80	20	68	32
2017/18	180	76	24	61	39
2018/19	161	73	27	62*	38*

* prediction based on the average from the previous school years

From the total number of 161 students who enrolled the Subotica Tech for the first time in 2018/19 school year, 137 (85%) were male students and 24 females (15%).

If we try to describe the typical student who enrolled the college, then his average mark during high school was very good and he had 30.90 points from a high school (max is 40).

3.1. Results

Students who did not certify the first semester: A total of 43 students out of 161 did not certify the fall semester (~ 27%). An average student who did not pass the semester during the high school had the average grade of 3.58 in the first year, in the second year 3.48, in the third year 3.60 and in the fourth year 3.72. We can say that during his secondary education he was on the border of good and very good average grades. For the average grade, he had 28.76 points. The average number of points in the entrance exam was 45.95 points (max 60), which gives a total of 74.71 points (max 100). Among them, the oldest student who enrolled was 44 years old and the average grade during his secondary school education was 2.80.

The average grades for all four years of secondary school are shown in the Fig.1. The weakest success that a student had during his high school education was 2.46.

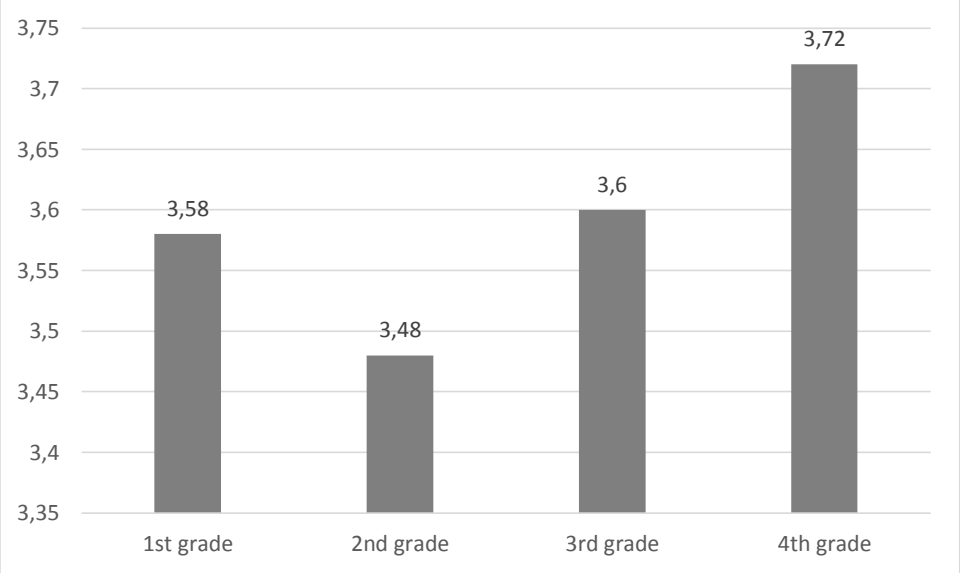

Fig. 1. The average grade during secondary school for students who did not certify the semester

Students who had 0 ECTS at the end of the first semester: From 118 students who certified the fall semester, a total of 14 did not pass any exams. An average student belonging to this group had a good average grade during his high school education (except in the third year when he had a very good average grade but at the very border of 3.50). The average

number of points in the entrance exam is 46.43, and among them there are 3 students who had a maximum score of 60 on the entrance exam. According to the success in high school and the achieved success in the entrance exam, the total number of points is 73.57 (max 100).

The lowest average score was 2.33, and the lowest number of points in the entrance examination 24.

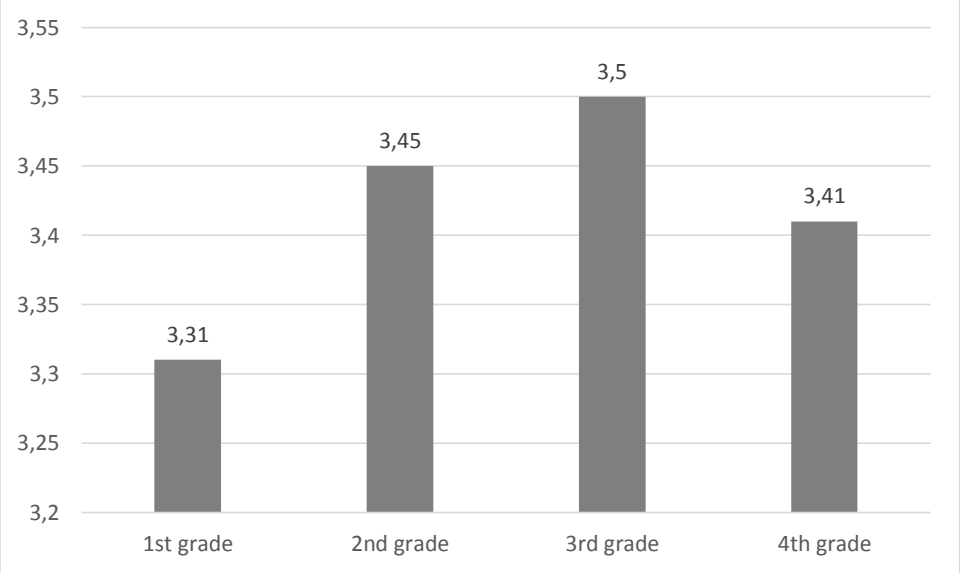

Fig. 2. The average grade during secondary school for students who had 0 ECTS at the end of the first semester

Students who had 5/6 ECTS at the end of the first semester (passed one exam): From 118 students who certified the semester, a total of 13 passed one exam (11%). An average student belonging to this group had a very good average grade during his education in high school, except in the second year when he had a good average grade. The average number of points in the entrance examination is 48. According to the success in high school and the achieved success in the entrance examination, the total number of points is 77.32.

The lowest average score was 2.62, and the lowest number of points in the entrance exam 32.

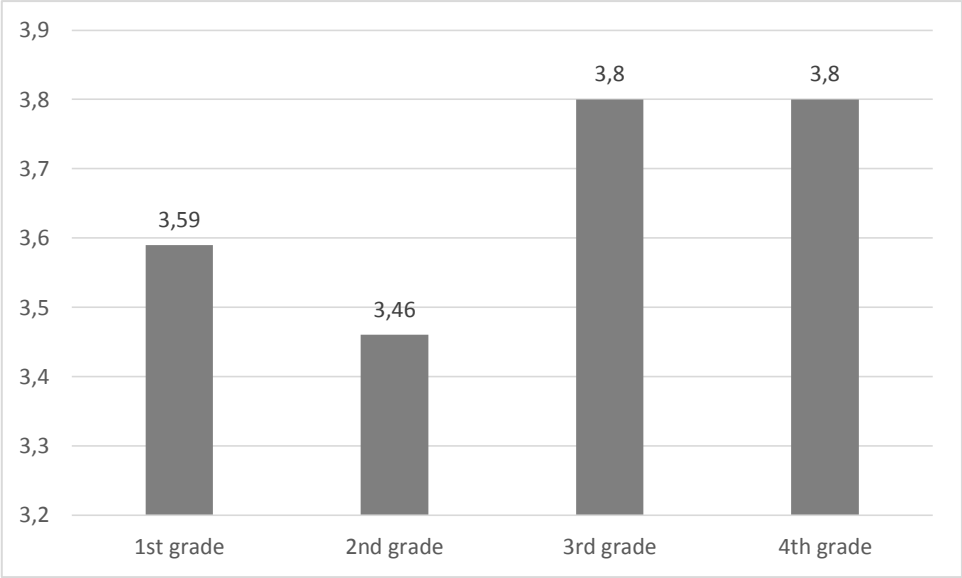

Fig. 3. The average grade during secondary school for students who had 5/6 ECTS at the end of the first semester

Students who had 10/11/12 ECTS at the end of the semester (passed two exams): From 118 students who certified the semester, a total of 16 passed two exams. An average student belonging to this group had a very good average grade during his education in high school, and the highest average was in the fourth year of high school. According to the success in high school and achieved success in the entrance exam, the total number of points is 77.71.

The lowest average score was 2.7, and the lowest number of points in the entrance exam 36.

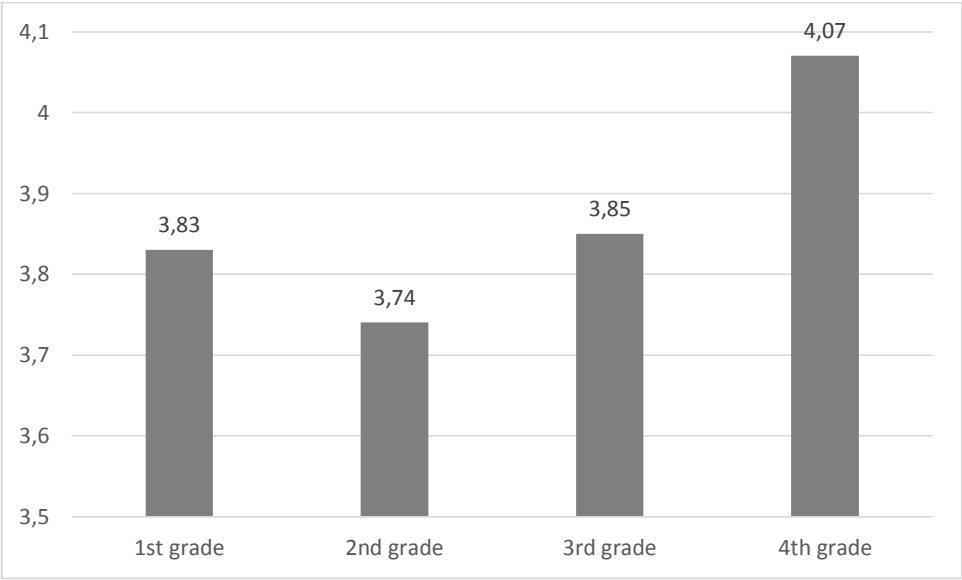

Fig. 4. The average grade during secondary school for students who had 10/11/12 ECTS at the end of the first semester

Students who had 15/16/17 ECTS at the end of the semester: From 118 students who certified the semester, a total of 11 passed three exams. An average student belonging to this group during his secondary school education was consistently a student with a very good average grade of 3.80 in all four years. According to the success in high school and achieved success in the entrance exam, the total number of points is 81.27.

The lowest average score was 2.71, and the lowest number of points in the entrance exam 36.

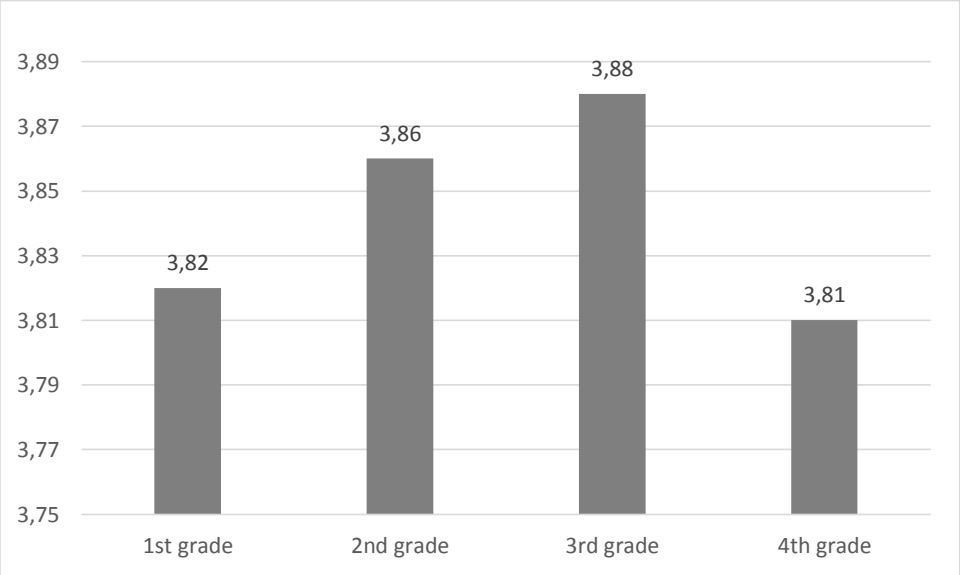

Fig. 5. The minimum average grade during secondary school for students who passed three exams at the end of the first semester

Students who passed all exams at the end of the first semester: From 118 students who certified the semester, a total of 33 passed all the exams from the first semester (28%). An average student belonging to this group had a very good average grade during his secondary school education in the first three years. The average grade was increasing from year to year, so in the third year it was almost an excellent (4.49 average) and in the fourth year excellent marks were achieved with an average of 4.64. According to the success in high school and achieved success in the entrance exam, the total number of points is 88.95. Of these, 33 students, 12 had a maximum of 60 points in the entrance exam.

The lowest average score was 3.38, and the lowest number of points in the entrance examination 24.

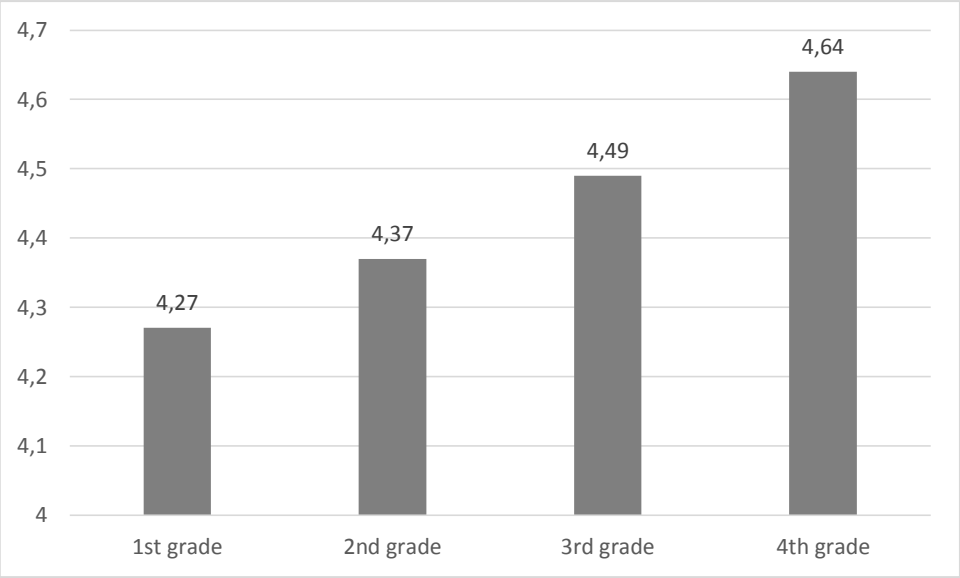

Fig. 6. The average grade during secondary school for students who passed all exams at the end of the first semester

Based on the results presented for the fall semester of the academic year 2018/19, it can be concluded that:

• The total student achievement according to the achieved ECTS credits differs according to the student's success during their secondary school. So, if we look at students who did not pass any exam, we see that they had (barely) a good average grade during high school, while students who passed all the exams at the end of the fall semester were with a very good average grade(at the very border to the excellent average grade) in high school.

• First year students who passed all exams in the fall semester had 17% more points in the entrance exam.

• Among the students who sat for all exams in the fall semester, 36% had the maximum number of points in the entrance exam. Among students who did not pass any exams, 21% had maximum impact in the entrance exam.

On the basis of the data previously published, we can conclude that there is a correlation between the successes in high school education and the efficiency in mastering the tasks enquired by the higher education system.

As an improvement measure, we can propose to explore, in cooperation with the Student Parliament, the reasons why students give up further studies. In addition to the basic assumptions from which we went into our research stating that the success of the studies is

related to the success achieved during secondary school, the research should be extended to collect information on motivation and expectations from higher education, past experience in higher education, attendance at classes, passed exams , average grade, etc. Also, we should find out what student perceptions are about the extent to which the expectations from the studies have been fulfilled and the opinions on the content and organization of the studies. As the first step in further research, a pilot project for monitoring student attendance has been introduced to identify students who do not attend regular classes and who are at risk of giving up further studies (Pinter, Pot, Maravić Čisar, & Čović, 2019).

Conclusion

For many students, the transition to university is a challenging experience that involves significant life changes and adaptation to multiple demands whose effects and significance must be interpreted in the sociocultural context in which they are produced. The objective of the present study was to analyse the association between pre-university achievement and adjustment to university. From a practical point of view, recognition of the influence of certain variables on the successful transition to university is not by itself sufficient, and empirical evidence must be presented. This will lead to the development of institutional support systems for those students in critical groups, thus promoting successful transition and lowering the dropout rates. The early dropout prediction indicates those students who are in most need of help. Tutors can focus on them and thus, increase their motivation and performance (Gogh, 2018) and teachers could apply innovative teaching methods (Molnar, 2011) and learning mobile (Molnár, 2012) support systems (Molnar, 2013) to increase student success. The motivation for this study was to understand the dropout problem and to learn how to combat and conquer the problem. The results show, similar to the research done in Granada (Rovira, Puertas, & Igual, 2017) that success during high school education has an impact on the success of studying (Ujbanyi et al, 2017). In the further work we plan to expand the research so that in addition to the grades from the high school and the success at the entrance examination, we will monitor the student's success during further education (until graduation).

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Digital education in digital cooperative environments

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Abstract

The globalizing world of international business, the mobility of workplaces and the accelerated technological development have made the educational sphere competitive as well. Consequently, educational institutions and the educational process itself have to come up with new methods to meet the respective challenges. Digitalization of education provides such an option as the education process serves as one of the foundations of the economic prosperity of any country. Our article focuses on the tendencies and phenomena generated by digitalization and introduce its immediate, practical impact on the teaching and learning process. We will emphasize such key competences, which are relevant and crucial for the support of digitalization in the 21st century.

Keywords: digital education, ICT-based environments, digital competences, teaching methods

1. Introduction and the relevant professional context

Digital transformation leads to two main issues, namely the ability of the education system to fulfil the emerging demands of the labour market and in return how the labour market can accommodate the altered social and economic needs. The main driving force behind the specific interactive and interdependent processes is the continuous development of information and communication technologies.

Accordingly, the activities facilitated by the digitalization process have become integral parts of everyday life in the information-based society. Therefore, as a result of the expanded and digitalized knowledge space information acquisition is not limited solely to schools.

Traditional learning environments have undergone a radical change and due to the increased availability of resources provided by the information-based society knowledge acquired in extracurricular frameworks either in one's leisure time or at home have gained increased significance (Balogh et.al., 2011). Students not only rely on theories and information based on their everyday experiences, but utilize up-to-date, authentic, and real life knowledge acquired from digital sources within the context of formal education (Gőgh, 2018). Hence students not only make a novel contribution to the educational process via the integration of a more and varied knowledge, but expect schools to provide educational materials that are similarly to those in the given individual's private knowledge space are dynamic, exciting, and current (Racskó 2017).

Nowadays information and communication devices have become indispensable to daily life coupled with the increasing medialization of learning and teaching via digital technology and the respective applications (Kis-Tóth–Lengyelné, 2012) The educational use of info-communication devices can be described as part of a process ranging from digitalized data recording, via the penetration of computers in the private sphere, the work and learning spaces, and everyday life until the emergence of the world wide web. It must be noted however, that some of these developments have reached the plateau of productivity, where further improvement is hard to achieve (Ujbanyi et al, 2017).

Daily use of digital media has shown a significant increase since 2008 while the number of mobile communication devices connected to the Internet grew as well. Such tendencies are reinforced by the example of the United States, a major point of reference regarding digitalization and the use of information and communication technology. Figure 1 shows that in 2008 the daily use of digital media was under 3 hours, out of which the use of mobile communication devices including laptop and smartphone amounted only to 20 minutes. Conversely in 2018 the daily use of digital media was over 6 hours, with 3,5 hours spent with mobile devices respectively.

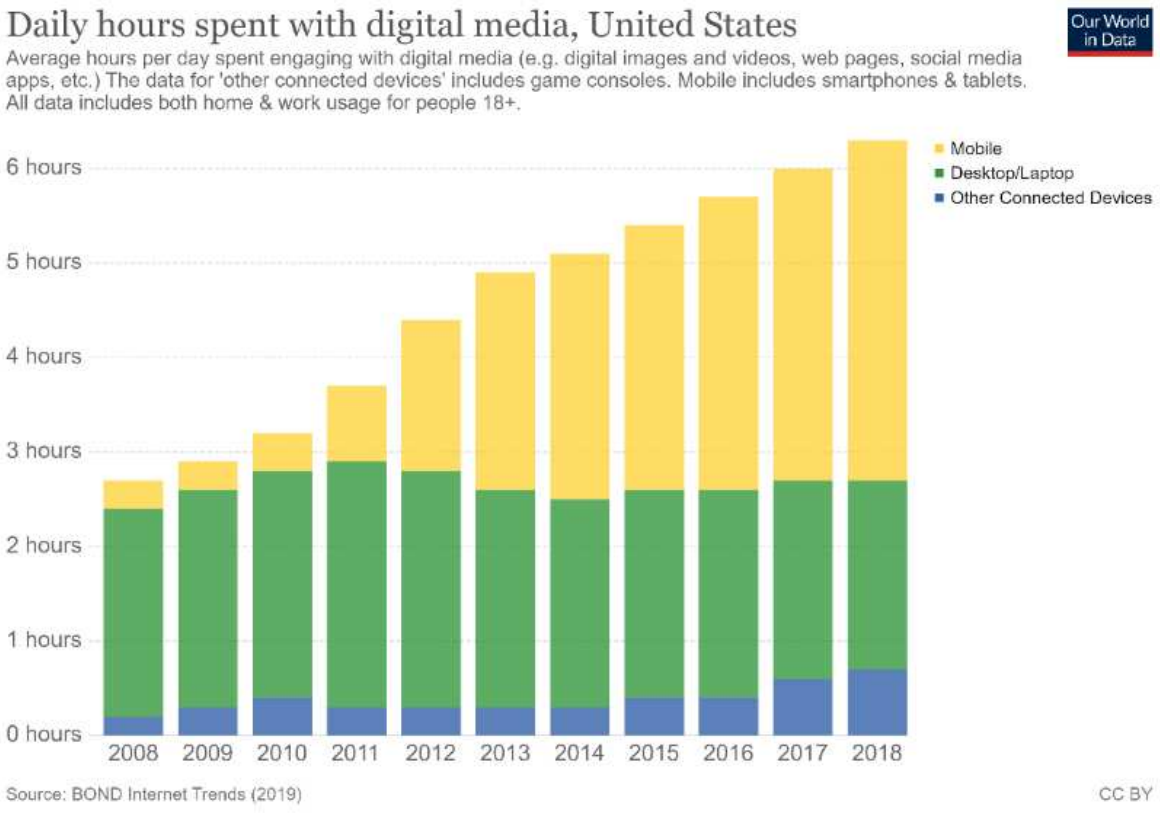

Fig. 1. Dialy hours spent with digital media, US
https://ourworldindata.org/rise-of-social-media

2. The role of competence-based instruction and digital competences

The emergence of digital media has divided the pedagogical profession into two groups techno-optimists and techno-pessimists demonstrating enthusiasm and reluctance or scepticism respectively. Furthermore, techno-optimists support the full digitalization of the education process via smart devices, electronic content and platforms eventually relegating the teacher into a programmer working with algorithms and smart devices. In their view printed books should be superseded by computer screens, student exercise books or notebooks would give way to tablets, writing would be replaced by fingers on the touch screen and individual learning routes along with student evaluations would be performed by non-empathic or indifferent artificial intelligence. Techno pessimists apart from the teacher's computer and projector and selected presentations refuse to admit digital technology and content into the classroom.

In a rapidly changing social and technological environment, increasingly competitive and highly interconnected world, under the umbrella of lifelong learning paradigm, each person will need a wide range of life skills and to develop them continually throughout life (Balogh et.al., 2012). Basically, life skills (Self-awareness. Empathy. Critical thinking. Creative thinking. Decision making. Problem Solving. Effective communication. Interpersonal relationship etc...) have increasing importance in education. 'Life skills are abilities for adaptive and positive behaviour that enable individuals to deal effectively with the demands and challenges of everyday life'(Vivekanand, 2015). In fact, this above-mentioned process has prioritized values, strategies and aims in public education emphasizing lifelong learning, especially focusing on self-directed learning and learning skills and competences (Gőgh&Kővári, 2018). Starting with the definition of competence: 'the ability to do something well', parallel to the list of life skills, the work-related competencies are playing important role as well. Basically, work-related competencies (n62) are starting the structuralization process. They are defined as 'A cluster of related abilities, commitments, knowledge, and skills that enable a person (or an organization) to act effectively in a job or situation. Competence indicates sufficiency of knowledge and skills that enable someone to act in a wide variety of situations.' These structural elements (knowledge and skills and later attitudes) are overlapped in strengthening inter- and transdisciplinary approaches in education. In fact, there are several connections with life skills and work-oriented competency areas. Regarding this growing complexity, the DeSeCo project stated: 'A competency is more than just knowledge and skills. It involves the ability to meet complex demands, by drawing on and mobilising psychosocial resources (including skills and attitudes) in a particular context.' In this project, the experts emphasized the role of communication, especially, practical IT skills. European Council Recommendation on key competences for lifelong learning defined key competences as: 'Key competences are those which all individuals need for personal fulfilment and development, employability, social inclusion, sustainable lifestyle, successful life in peaceful societies, health-conscious life management and active citizenship.' The Recommendation indicated the growing importance of competency areas such as: Literacy competence, Multilingual competence, Mathematical competence and competence in science, technology and engineering, Digital competence, Personal, social and learning to learn competence, Citizenship competence, Entrepreneurship competence, Cultural awareness and expression competence. Turning to the Digital competence, the Recommendation defined this competency. (Council recommendation, 2018): 'Digital competence involves the confident, critical and responsible use of, and engagement with, digital technologies for

learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking.'

On the individual level digital competence is part of the 8 competences required for lifelong learning determined by the European Union. Apart from the recognition of the need for digital competence member states of the European Union have not clearly established which competences are included in the respective category. Experts of the Joint Research Center, the scientific hub of the European Commission focused on the elaboration of a framework system describing the digital competences of European citizens and developed other framework systems as well.

The digital competences of European citizens, currently known as Digital Competence Framework for Citizens were determined in order to bridge the gap between the education sphere and the expectations of the labour market. The development of the framework started in 2005, the first version (DigComp 1.0) was published in 2013, the second (DigComp 2.0) in 2016, while the latest version (DigComp 2.1) was released in 2017.

Parallel to the growing complexity and structuralization of the competency areas, there are two trends, which are relevant to this paper:

1. Complexity of the basic skills: (4 C): critical thinking, problem solving, information processing, creativity and innovation, communication and collaboration.
2. Growing role of transversal competencies in public education, this is the complex, networking, competency-based world, which is based on some transversal competency areas: Intercultural skills & global awareness, Flexibility & adaptability, Strategical & innovative thinking, Organization & time management, Decision making, Teamwork, Empathy / ability to build relationship, Problem solving, Learning orientation, Negotiation skills, Leadership, Collecting and processing information.

The transversal competences indicate clear direction on competency development to the experts, decision makers and practitioners. Namely increasing inter- and transdisciplinarity in the school systems. It is obvious, that the wide range elements of competency lists are

relevant to the experts and the decision makers, but it is not pragmatic to the practitioners. In order to solve this dichotomy (from theory to practice and from research to action), the very first point we have to focus on is the meanings and definitions of 'transversal'. According to the Cambridge English Dictionary and Math Open Reference, transversal - from the geometric point - is 'a line that crosses two other lines'. In order to understand the role and place of digital competence in this process of 'competency tsunami' and competency development, it is necessary to stress the dilemma, namely whether the development of digital competence is a subject-oriented or transversal approach? In fact, the traditional way of curriculum development is subject-based, but the abovementioned trends and processes require a growing transversal approach. In practice, on the one hand it means that systematic curriculum planning has to become a relevant component of digital competence related to the different subject areas. On the other hand, this process requires collaborative curriculum planning from the teachers.

3. The work context of teachers

As Kata (2006) asserts the preparation for classes and the management of the learning process are crucial aspects of any teacher's work. The main objective is to enable students to acquire new knowledge in the most effective way possible while meeting the requirements of the future and accommodating the respective continuous changes. The design of the learning process should include the determination of how much time should be spent on teaching the given learning unit along with selecting the specific teaching methods and technological approaches. Since in case of several subjects a textbook is not or at best partially available, the compilation of class or lecture materials, notes and assignments is a time and energy consuming process. Shared content development can provide an answer to this problem along with other advantages including professional development and improved academic performance for teachers and students alike. Below we provide a brief introduction of the given reasons and the respective consequences.

Research results have proven that reform measures and the resulting higher investments in the education sphere do not guarantee improved academic performance (Barber & Mourshed. 2007). The quality of the teacher and the teaching process is a much more significant factor (OECD 2005). The evaluation of the teaching activity is a multivariable process. Edmonds (1979) had established 5 key factors determining the efficiency of the teaching effort including appropriate classroom management, emphasis on the development of basic values, the provision of steady and safe educational environment, maintaining high expectations

towards student performance, and frequent evaluation of student progress. While such criteria have been considered valid until the present day, additional factors have been included. Accordingly, professional cooperation between teachers has crucial significance along with maintaining positive class atmosphere, promoting the greater involvement of parents, and assuring the optimal content of the education process (Scheerens 2004, Bander et. al. 2015).

Consequently, more and more schools emerge where the learning and professional development of teachers is a crucial component of the everyday operation and emphasis is placed on cooperation. In such stuck and moving schools (Rosenholtz 1985) the teaching staff is motivated to cooperate if such professional challenges occur, which an individual cannot meet on their own. While the most frequent difficulty is the use of digital devices, other problems include aggression and coping with or integrating students with special needs. If teachers possess appropriate digital skills, cooperation can take place without temporal or spatial restrictions (Tóth-Pjeczka 2016).

ICT devices help the identification of methods applicable in the given situations. Said devices and instruments have increasing significance in the education process and facilitate student-centred and technology-based teaching and learning (Hunya 2014). Teachers are expected to integrate and regularly use these devices in their work (Bartha & Sáfrányné 2018) and the domestic and international tendencies including such micro trends and models of school digitalization as the Flipped Classroom, BYOD theories, gamification and electronic learning environments have become more prevalent as well (Molnár 2018). Such developments pose a significant challenge for most pedagogues as they have to learn the use and operation of the given technology on their own.

Yet the type of co-operation is crucial as according to the TALIS (OECD 2009) co-operation restricted to exchange and coordination is considered only functional and sufficient for the operation of the given system, while the ideal form is professional collaboration promoting team teaching, mutual class visits, development-oriented feedback, and coordinated home assignments. Teachers involved in collaborative team efforts have a higher performance than those working alone. Thus cooperation can be considered as an efficiency factor and its success is based on the formation of professional capital (Hargreaves & Fullan 2015). Professional capital consists of a human component, namely the available features and attributes that can be improved in addition to the skills and competences. It also includes the social capital standing for the benefits of the given networking system, and is complemented by decision-based capital, that is, methods acquired from experienced colleagues, and coping

with the respective complex decision-making situations and solution options. In this vein professional capital is considered the sum of all advantages gained from professional collaboration. The resulting Professional Learning Communities (PLC) facilitate collaborative learning efforts. Accordingly, teachers work together continuously as partners in order to achieve a pedagogical objective. Thus their learning effort is motivated by helping the students, which means significant benefits for their own professional development as well. As a result of methodological cooperation the given methodological repertoire or arsenal expands along with that of self-esteem and confidence and the need for self-training and development (MacGilchrist – Myers – Reed 2004). Other advantages or benefits of teacher collaboration include setting examples for students, reduction of stress levels, avoiding teacher burn-out, and the feeling of being a member of a team (Tóth-Pjeczka 2016a).

The development and self-improvement of the members of the pedagogical profession assure the higher standards and appropriate quality of the education process, thus it has a positive impact on students as well (Cordingley et al 2003). As Köpeczi-Bócz (2006) asserts high standard instruction should be commensurate with the skills of students thereby facilitating the most optimal pace of development along with meeting professional standards and the latest scholarly requirements. Thus knowledge will always be up-to-date enabling both teachers and students to keep pace with the development of science. In sum there are four main components of high quality instruction, that is meeting the respective social and economic demands, equal access to reliable and identical standard knowledge, achieving satisfaction on the part of society, economy, and students, and facilitating the acquisition of knowledge considered useful by the given individual. As Benedek (2006) asserts the efficiency of information flow among students and teachers, in other words, the productivity or success of the teaching effort depends on 5 factors. The selection of facts and data and their conversion into information followed by the creation of knowledge belong to the field of cognitive psychology. Accurate presentation and coding of information facilitating the understanding of the given information is a task of pedagogy. Information technology focuses on the forwarding and transmission of information to the respective students. While errors can take place in any of these stages, and none of them work flawlessly on their own, the combined application of the various methods and increased use of ICT devices can make information transmission more effective. Naturally, the system includes factors that can frustrate the realization of the original objectives. These include distant hard to achieve, or too ambitious training objectives, the lack of regular and on-time feedback, inappropriate group

atmosphere, and non-student friendly learning schedules disregarding individual problems or circumstances, eventually resulting in attrition or dropping out. The self-feeding aspect of learning can counterbalance such setback factors. Accordingly, learning can be viewed as a cyclical process. Achievement can increase the enjoyment of learning, which can strengthen self-confidence leading to higher expectations towards the learning process. The subsequent increased motivation paves the way for improved performance and better academic results. The cyclical self-feeding aspect of learning is shown by Figure 2 (Zrinszky 1995).

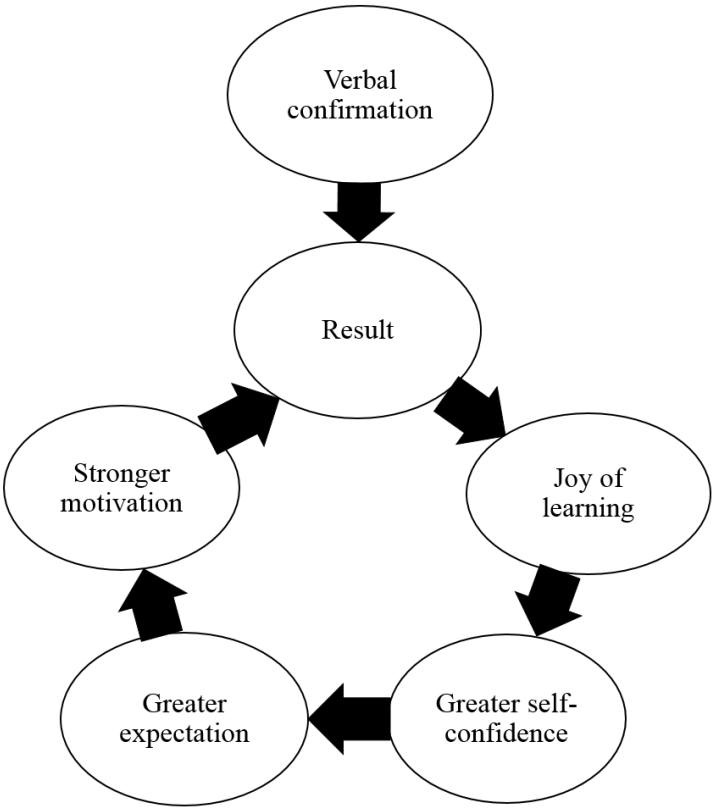

Fig. 2. The self-feeding aspect of the learning process

Zrinszky, L. (1995). *A scientific approach to adult education: Introduction to andragogy*

The figure illustrates that teachers can intervene in the learning process at several instances. One prerequisite of successful teaching is if pedagogues collaborate and work together in harmony. Reinforcement is important for all learners, and the experience-based knowledge acquisition leads to joyful learning and improved self-confidence. If students have greater expectations toward themselves and the learning process, their motivation can further increase and this will result in higher academic performance. Consequently, teachers see such developments as an incentive for additional effort, intensified professional growth, and continued successful collaboration.

4. Summary

We believe that the efficiency and appropriateness of the education process depends on the teacher's ability to recognize when should digital technology be used and when they can rely on traditional methods. Such competence should be the guiding approach not only in the present, but throughout the 21st century. The appearance of cinemas did not phase out the theatre, and after a beginning decline stage books have stabilized their position compared to the e-book reader. In our treatise we will provide a historical overview and in the theoretical segment we will rely on the achievements of cognitive psychology in exploring the positive and negative consequences of the use of digital technology. We think that info-communication devices are only means or tools and not the end or goal of the education process. Yet such tools can help to prepare the teacher generation of the future to meet the challenges posed by digital pedagogy and provide an effective answer as well.

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Developing an assessment protocol to identify the characteristics of ASD using eye-tracking for educational purpose

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Abstract

The understanding of how written social information is processed by individuals with autism spectrum traits is important for the development and implementation of suitable educational interventions. The use of eye-tracking methodology offers us the possibility to analyze how information is being selected and has a great potential to inform our understanding of cognitive processing in individuals with neurodevelopmental disorders. Our main goal is to develop an assessment protocol, which could identify if there are differences in the way individuals with low autism spectrum traits and high autism spectrum traits process written social information. This information helps to specify the development of educational techniques for individuals with autism spectrum disorder. This study provides the necessary steps for the protocol implementation. We propose an experimental design that can clarify if there are some specific visual patterns when processing social information in the context of autism traits. The findings of our work could document future intervention techniques for social skills.

Keywords: social information; eye-tracking; autism spectrum traits; special education

1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by some degree of impaired social behavior, communication and language, along with restricted patterns of interest and repetitive behaviors (American Psychiatric Association, 2013). Social communication impairments along with the presence of restricted interests and repetitive behaviours represent the central features in ASD (APA, 2013).

Inclusion of students with disabilities has increased over the past 20 years. The inclusive practices have given students with disabilities to gain knowledge in general education curriculum and learn academic skills. While the students with ASD are unique, their strengths and needs will surely differ (Ferraioli & Harris, 2011). In order to best support students with

ASD, it is essential that general teachers, special education teachers, and parents collaborate together to better understand and develop the unique strengths and needs of these students.

The Centers for Disease Control and Prevention‘s most recent data regarding autism prevalence, released in April 2019, estimated about 1 in 59 children identified with ASD. While research has yielded much on understanding the biology of autism, the mechanisms and ways in which information is processed and is being used by people with ASD remains a challenge.

The most researched diagnostic instruments for ASD, such as Autism Diagnostic Interview-Revised (Rutter, Couteur & Lord, 2003) and Autism Diagnostic Observation Schedule (Lord. et., al., 2012) provide us some clues regarding the behaviours that are being investigated in the assessment phase. Therefore, the clinicians should consider children’s social initiations and responses, their joint attention episodes, their social play and their repetitive and stereotypic movements (APA, 2013). Even from the beginnings of research in ASD and also the above mentioned assessment batteries introduce the idea that there are some abnormal gaze patterns in individuals with ASD that clinicians should pay attention to (Kanner, 1943). In the last decade the advances in technology, more exactly the use of the eye-tracker in the research of ASD allowed us to investigate this unusual eye contact pattern and a large number of eye-tracking studies supported the idea of the deficits in attention to social information as a key feature of ASD (Klin, 2013; Sasson & Ellison, 2012; Papagiannopoulou, Chitty, Hermens Hickie & Lagopoulos, 2014).

When analyzing the studies in this domain, different stimuli have been used and diverse regions of interest within these stimuli and the majority of the studies reached the same conclusion of social attention differences, ranging from decreased fixation to others’ eyes (Klin, 2013) and social scenes (Chawarska, Macari, & Shic, 2013), to aberrant gaze toward dynamic social stimuli in older cognitively-able individuals (Rice, Moriuchi, Jones & Klin, 2012). However, the increased heterogeneity across eye-tracking studies makes definitive conclusions regarding the exact nature of gaze abnormalities unclear (Frazier et.al., 2017). Findings from two recent meta- analyses show small-to-medium reductions in looking to socially relevant regions, particularly eye and whole face regions, (Papagiannopoulou, et.al., 2017) and increased gaze to less relevant regions of the stimulus (e.g., nonsocial regions) (Chita-Tegmark, 2016).

The results from more than one decade of eye-tracking studies in the domain can be divided in two major approaches. The first approach, referred as social processing theories, highlights abnormal attention to social and affective stimuli, and the main theories that sustain this pathway are theory of mind (Baron-Cohen, Leslie & Frith, 1985), intentional attunement (Gallese, 2006) and social motivation theory (Chevallier, Kohls, Troiani, Brodkin & Schultz, 2012). The second approach refers to a more general way of cognitive processing, a nonsocial way, which is independent of the social or affective content. Here we mention the theories, which state there are more general executive functions deficits in ASD (Hill, 2004) and the theory developed by Frith and Happe (1994) that refers to hierarchical dimensions within perceptual patterns (eg. global vs. local). However in some cases it is very difficult to make a clear distinction between the two types of approaches, particularly because the direction between cognitive processing and the stimuli that are being analyzed is bidirectional. For example, when analyzing the way executive functioning may explain the social deficits in ASD, the findings may be influenced by the affective nature of stimuli while attention to social information can be influenced by basic sensory processes and stimulus complexity (Frazier et. al., 2017).

Therefore the studies using eye-tracking methodology most likely will not provide direct evidence for confirming or excluding some of the above mentioned theories, but it can inform our understanding of core features that are prominent in a majority of ASD cases. Moreover, when it comes to intervention for social deficits, the most used methods involve social scenarios modeling. For example, Social Stories (SS) are considered among the most promising interventions for children with ASD for improving social skills (Heward, 2006). Although practitioners use multiple visual support for delivering SS, Carol Gray (1995) proposed the technique based on written social rules which are necessary to be respected when interacting with others and which also have the role of self-regulation. As mentioned above several studies have documented the presence of social attention deficits when looking at social scenes or photos, but to our knowledge there are no studies that investigate the way individuals with ASD process written social information in terms of their visual patterns. This aspect could represent an important piece of the puzzle when it comes to understanding how individuals with ASD process the social information especially because an alternative of learning from face to face social interactions is the explicit learning of social rules that govern our behaviors. However, if we want to use these types of techniques in practice, learning explicit social rules for a particular situation, the individuals need to use their reading

abilities. When it comes to reading abilities there is one important aspect that also needs to be considered, which is reading comprehension (Benedek-Molnár, 2013).

1.1. Reading comprehension in individuals with ASD

Reading comprehension is part of the reading ability, which is broadly argued to be an impaired ability in children with ASD. There is evidence that some children with ASD can read accurately, but even amongst these children, levels of reading comprehension are poor (Minshew et al., 1994; O'Connor & Klein, 2004; Snowling & Frith, 1986). The process of reading comprehension seems to be influenced by language development and decoding skills, and it includes a variety of cognitive skills (Gogh, 2018). When trying to explain the reading comprehension deficits in ASD population there are two possible explanations. The first one may be that the cognitive impairments related to the social communication deficits that characterize ASD overlap with the cognitive demands of reading comprehension (Solari et.al., 2017). Meaning that the failure to acquire reading comprehension in the school age years is an important part of the cognitive and social communication phenotype for individuals with ASD (Norbury & Nation, 2011).

On the other hand, Cornoldi, Giofré, Orsini, & Pezzuti, (2014) propose that when it comes to the understanding of written information we should pay less attention to the general intelligence and more to the factor indexes representing intelligence: verbal comprehension (VCI), perceptual reasoning (PRI), working memory (WMI), and processing speed (PSI). Therefore reading comprehension deficits in ASD may be predicted by a specific cognitive profile, including verbal comprehension and perceptual reasoning. One can also define reading comprehension as the ability to decode, to process the information, to operate with the information in the working memory, and then understand the spoken language. Word decoding seems to be more important at a younger age and; linguistic comprehension becomes a more pertinent predictor of reading comprehension in middle elementary years and later (Kendeou, Van den Broek, White, & Lynch, 2009; Vellutino, Tunmer, Jaccard, & Chen, 2007).

In light of this approach and considering the need to have a deeper understanding of how children perceive social information we propose to explore the possibility if the two factors mentioned by Cornoldi et al, (2014) VCI and PSI represent good predictors for information understanding. There is a gap in the present literature considering whether if social information, for example from social scenarios, is perceived in a different way than non-

social information. Information that can be useful for understanding different cognitive profiles of children with ASD and can applied in the development of interventions for social skills. Therefore we plan to assess reading comprehension and visual attention of children with ASD using a technology-based approach based on eye-gaze methodology.

For identifying visual attention patterns in relation to text reading in a more accurate and objective way we propose to use eye-tracking methodology**.** Based on prior studies using eye-gaze methodology we hypothesized that, due to their specific abilities children with ASD may focus on those parts of the text that are not relevant for text comprehension, limiting their understanding of the written information. Another possible assumption is that individuals with ASD will use different visual attention pattern when analysing social vs. non-social information. In order to test our assumptions we propose the following theoretical model based on information processing theory (Figure 1), which considers visual attention and reading comprehension as predictors of how social information may be understood by children with ASD.

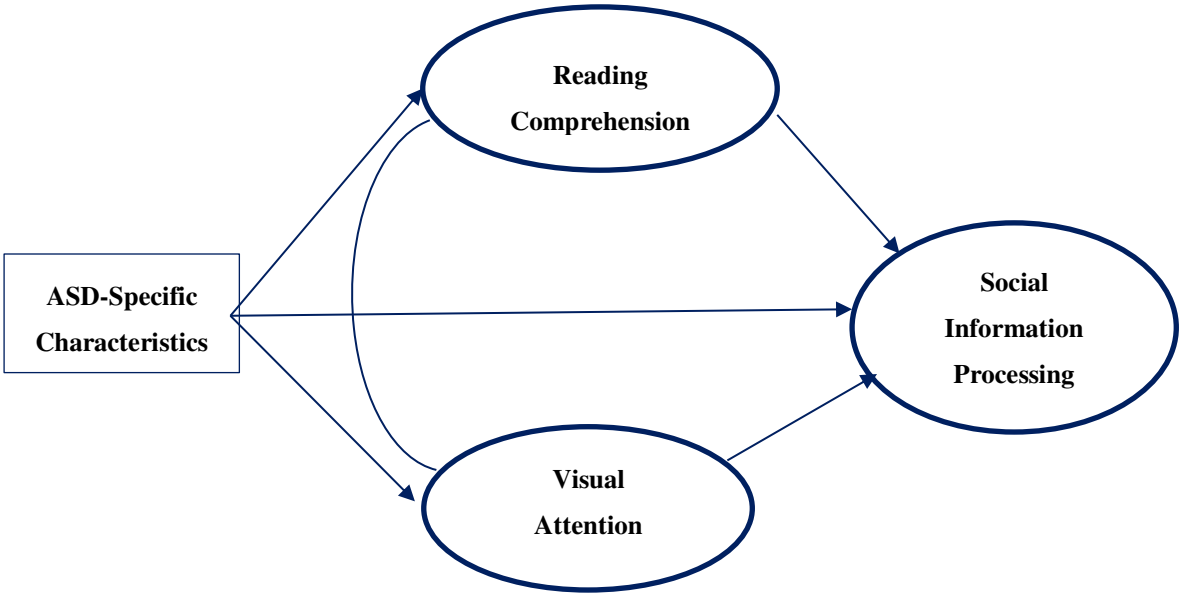

Fig. 1. A theoretical model which may explain the social information processing in children with ASD

Nowadays, eye-tracking measures of social attention are considered to be a potential biomarker for ASD (Murias et al., 2017). These types of measurements can offer us important objective and accurate information regarding the way children process social information. During our study, we plan to observe and record the route of the gaze of the participants, a research-grade device, the Gazepoint GP3 eye-tracker will be applied, which had successfully been applied in some previous research (Edelman, Meng, Gulachek, Cline & He, 2018,

Kovari, Katona & Costescu, in press). The data obtained with the GP3 will be used with OGAMA (OpenGazeAndMouseAnalyzer), which is an open-source code application (Adrian Voßkühler) that tracks eye and mouse movements and record and analyse the received parameters. The use of eye-tracking measures together with the analysis of the visual patterns could provide valuable information regarding the visual attention of children with ASD in reading, which previously has been limited to some standard paper-pencil tests.

Thus, our main goals of the study are based upon the following: a) the demand for better understanding of the way children with ASD perceive social information; b) the need for developing new effective interventions for improving social skills which may impact daily activities of children with ASD; and d) the necessity to increase accessibility of evidence based-interventions for children with ASD. In order to answers the above challenges, firstly we need to test and validate our proposed theoretical model. In this way we could better understand which are the predictors of accurate social information processing in the case of children with ASD.

When it comes to autism spectrum traits it is believed that individuals with high autism spectrum traits are linked to difficulties in understandings others perspective and with reduced empathy (Wheelwright *et. al.,* 2006). Although past research has linked autism spectrum traits to deficits in the perception of others, as noted earlier, it remains unclear whether autism spectrum traits also predict deficits in social cognition. As mentioned above, our main goal is to develop an assessment protocol, which could identify if there are differences in the way individuals with low autism spectrum traits and high autism spectrum traits process written social information. The assessment protocol has three main objectives, as it follows:

Objective 1: to identify if there are differences in the social information processing (considering their visual attention patterns and reading comprehension) between individuals with high and low autism spectrum traits.

Objective 2: to investigate if there are differences in the visual patterns when reading social vs. non-social information in both groups.

Objective 3: to investigate the association between high autism spectrum traits and their social cognition considering also their visual attention patterns.

2. Methodology

2.1. Participants

In our study we expect to enroll approximately 80 subjects. The participants' age will vary from 18 to 20 years old. The sample will consist from first year university students in Pedagogy and Special Education, Babes-Bolyai University, Cluj Napoca. All of the participants will sign an informed consent form. The exclusion criteria will consist in having a diagnostic of a psychiatric disorder or severe visual impairments.

2.2. Instruments

Autism Spectrum Quotient (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) is a 50-item scale that measures ASD traits both in clinical and community samples. The questions from AQ are rated on a four-point scale from "Definitely Disagree" to "Definitely Agree" and included items such as "I enjoy meeting new people" and "I would rather go to a library than a party". The instrument has 5 subscales measuring: social skill, attention switching, and attention to detail, communication and imagination. The AQ has good construct validity and internal consistency (Cronbach's alpha 0.83).

Dewey Story Test (Dewey, 1991) It is a vignette-based test that measured implicit social cognitions and it requires that participants depict violations of social norms using eight sample situations. The participants are explicitly asked to rate how they thought most people would judge the described behaviour in the stories if they witnessed it, according to a multiple-choice answering format. (See an example in the methodological part).

Prove MT di Comprensione Elementari e Medie (Cornoldi & Colpo, 1995). The MT reading tests, prepared at the Institute of Psychology of Padua by the MT research group, allow us to examine the reading comprehension from the first class of primary school to the third class of middle school. These tests are differentiated by age: the syntactic and semantic difficulty, the length and the size of the typographical character of the pieces, vary according to the class they are addressed. The MT reading tests are divided into tests of comprehension and tests of correctness and speed, and allow the assessment of the levels of learning achieved by children at different times of the school year (Molnár 2013) (Ujbanyi, 2017). Although our participants are older than third class of middle school we use this texts in order to analyse the visual patterns of the participants in text readings not the comprehension level.

2.3. The evaluation of the parameters of the eye movement

During the experimental tasks we plan to analyze the following parameters: the number of fixations, the average fixation duration as well as the average saccade lengths in pixels. We also plan to examine the attention maps generated by the OGAMA software, which will be determined while recording the route of the gaze. In the attention map there are the following colors: red, yellow, green and transparent field. The red color means that the participant focused his/her attention in that region for a longer period of time; yellow color means that the participant focused their attention in a specific area for a medium length of time; green means that the participant focused his/her attention for a short time and transparent field means that the participant focused his/her attention only for a very short time. Considering all the above-mentioned parameters we will try to extract visual attention patterns that may be characteristic for a certain type of participants (low or high autism spectrum traits) of for a certain type of text (social vs. non-social).

2.4. Procedure

The GazePoint 3 (GP3) eye-tracker hardware unit and the OGAMA software package will be used in the research to observe eye-movement tracking and to record the metrics.

2.4.1. The Gazepoint GP3 eye-tracker hardware unit

The Gazepoint GP3 eye tracking system will be used to collect data from participants. This system is recommended for use with single displays up to 24″ and provides data at a 60 Hz sampling rate. Data recorded includes a user's left and right pupil diameter (in pixels, corresponding to a fraction of the camera image size) and left and right point-of-gaze (x and y-coordinates on the screen). The software also enables capture of the location of each eye in 3D space, with respect to the camera, as well as pupil size, all in meters. Fixation data (x and y-coordinates and duration) will be also available. GP3 is an ultra-portable device (320 x 45 x 40 mm, 145g) that can move 25 cm horizontally, 11 cm vertically and 15 cm in depth; it can be fitted on the monitor and uses infra camera observation and image procession to detect and follow eye movement with 60Hz sample rate.

2.4.2. The OGAMA software package

The OGAMA (is an open-source code application that allows recording and analyzing eye-tracking and mouse tracking data from slideshow eye-tracking experiments. The main

features of the application include slideshow design, database-driven preprocessing, attention map creation, filtering and recording of gaze and mouse movement data and the areas of interest definition and saliency calculation (Itti, and Kock,2001) (Sziladi, 2017). Furthermore, data stored in the database can be exported for different statistic software in proper formats, which eases efficient statistic evaluation. The application supports several gaze routes observing and recording hardware units, including the Gazepoint GP3 hardware unit as well.

2.4.3. Implementation Steps

Firstly the Gazepoint software package will be installed; the package contains the camera driver. After successful installation, the device will be connected through a USB and it will be placed under the monitor which will be used to run the experimental tasks approximately 65 cm length distance from the eyes. Later the Gazepoint Control application will be started, which supports the configuration and the start of the gaze-date server, ensuring real- time information obtaining. Afterwards we will start the OGAMA software.

The participants will enter in the laboratory one by one. At the beginning they will sign an informed consent and a questionnaire containing their demographical information. They will answer then to the questions from the AQ in order to identify their profile as having low or high autistic traits. All the data gained from each participant will be saved on the server. Data collection will occur during one single session. Right before starting the experimental task the calibration process needs to be done. The calibration will consist in tracking a circle with eye movement from the top left corner of the monitor without moving their heads. After the calibration the participants will see their eye gaze rendered on the screen in real time in order to qualitatively verify the accuracy of their calibration. If the calibration process will fail we will ask the participants to do it one more time. The experimenters will check the distance from the monitor and the calibration process for each participant.

After calibration, participants will be instructed to look at the screen and select with mouse the correct answer. Afterwards we expect the participant to engage in two consecutive tasks: nonsocial written information and social scenarios (see some examples for Task 1 and Task 2 below). Each task will have 8 written texts and each text will have a set of questions. The social scenarios will have two types of questions: which measure social cognition and comprehension. The nonsocial written information text will have only the comprehension questions. Most importantly, each of the two tasks will require the participant to focus his/her

attention in the center of the screen and all input will be provided by mouse clicks on the screen, so participants did not have to divert visual attention away from the screen, to the keyboard. Each task will take a variable length of time to complete, depending on how quickly participants input their responses. All the tasks will have a limited area in which relevant information will be displayed and for purposes of this paper are considered to be low in visual complexity. During the reading process and also while they answer to questions the eye movement parameters will be observed and recorded, and after finishing the test, the data will be saved into a database for further statistic evaluation.

Task 1: Social Scenario extracted from Dewey Story Test (Dewey, 1991)

"6:1 Roger, 22, lived in a rented room alone. He was quite a nervous person, but it seemed to him that he felt better if he ate every two hours and limited his diet to certain foods. One day, a lady called and invited him to dinner, explaining that she was a friend of his parents. Roger gladly accepted. ***However, he warned his hostess that he eats no meat and would like his vegetables served unsalted.*** *6:2 When Roger arrived at the appointed time, he recalled that he had not eaten for two hours.* ***Without wasting any time, even before the introductions, he asked his hostess when dinner would be served.*** *6:3 She replied that it would be about an hour before the meal would be ready.* ***Hearing this, Roger opened his briefcase, removed an apple and some nuts, and promptly ate them.*** *6:4 After that, he was introduced to the family, and they sat talking for an hour. Just before dinner, the hostess showed him an attractive platter of fruits and vegetables, asking whether it looked like enough. '****It looks fine, thank you', Roger said, 'but if you don't mind, I will wait another hour to eat. I just had some food an hour ago'. "***

Social cognition questions

Rate how do you think that most people would judge the described behaviour in the stories if they witnessed it:

6.1 a. It is strange to take food from strangers yes/no

b. It is normal/not normal

c. Because he is a vegetarian it's like being allergic, then you should also tell people yes/no

6.2. a. It will be strange yes/no

b. One usually does not act like that yes/no

6.3. a. If you're hungry you must eat yes/no

b. You shouldn't eat anything before dinner yes/no

c. Fruit is not wrong to just eat, but the nuts? yes/no

Comprehension question

Roger needs to eat every two hours because:

a. he has a medical condition

b. he has lactose intolerance

c. he becomes irritable

d. he needs to have a snack before dinner

Task 2: Non-social information – sample from Prove MT (Cornoldi & Colpo, 1995)

"The days began to get longer: with his moped, at the end of the work, Mircea was going to explore the river and its fluencies upstream from the city. He was particularly interested in the places where the water flowed further down the paved road.

Once he was lost: he was going through steep ravines and you swarmed, and he could no longer find any path, he didn't even know where the river was: suddenly, removing some branches, he saw, at a few palms below him, the silent water - it was a wide area of the river, which had formed a small, calm accumulation - light blue in color, looking like a small mountain lake……"

Comprehension questions:

Mircea searched, along the river bank, for a place:

a. in the vicinity of the road.

b. away from traffic and dust.

c.where the road goes down.

d. where it was possible to reach on foot.

3. Data analysis and expected results

For the data analysis we will use SPSS 20. We can answer to the research questions by using correlational design and we can test the mentioned predictors from the theoretical model with multiple regression analysis. In order to test some possible mediators we will use the mediation analysis a methodological approach proposed by Preacher and Hayes (2008).

In terms of the possible findings, we expect to identify some differences in the social information processing, considering both their visual attention patterns and their ratting the social vignettes (from Dewey Story Test), between individuals with high and low autism spectrum traits. Meaning that we expect that individuals with high autism spectrum traits to focus less on the strange behaviours from the vignettes and therefore rate it as more usual behaviours than individuals with low autism spectrum traits. However, we plan also to test to what extend one or another visual strategy of analysing the texts may also influence the rating of the behaviours or if the comprehension of the text influences in a way the answers of the participants. Considering the fact that the comprehension questions are very easy for their age level we do not expect to find any significant differences neither between groups nor between texts. The only difference that we expect to see in terms of how they understand the texts (reading comprehension) will be incorporated in the composite indicator of the visual patterns. In order to better analyse reading comprehension as a predictor for social information processing a group of individuals with a diagnosis of ASD is needed to be included in the study.

Another interesting questions that our study tries to answer is whether there are differences in the visual patterns, fixation time and area of interest when reading social vs. non-social information. Considering the approaches described in the introduction part for the understanding of social and attention deficits of individuals with ASD, we do expect to find some differences in the way social vs. non-social information is perceived and processed. One of our assumptions it that when social content is being analyzed people tend to focus their attention for a longer period of time. It would be interesting to see if the relation between high autism spectrum traits and the ratings of the vignettes is being mediated by a particular visual attention patterns terms of area of interest or fixations. Also interesting analysis could be developed if we consider the five subscales of the AQ. For example, it would be interesting to see which of the following: social skill, attention switching, and attention to detail, communication or imagination better predicts social cognition in both groups.

4. Conclusion and discussion

Children with autism may have trouble understanding or communicating their needs, they can have difficulty understanding some classroom instruction, and they have difficulties with imaginative or creative play interactions and mean that many teaching strategies will not be effective. It is necessary to better understand the differences of students with autism to

develop specialized curriculum content, teaching methods, learning environment, support and services for these children.

Our main goal is to develop an assessment protocol, which may test if there are differences in the way individuals with low autism spectrum traits and high autism spectrum traits process written social information. The answers to this question may have important implications not only for the understanding of how individuals with ASD think and process social information but also can guide the development or improvement of the techniques that aim to target social skills and inclusion these students in the general education process.

Although our work is only in an incipient phase, proposing an experimental design for testing an theoretical model, we believe that it has a great potential in the domain of eye-tracking application for special education. Furthers steps in our work, after implementation of the proposed experimental design, will be to involve first grade relatives of children with ASD. Only after our theoretical model is being validated on several samples we propose to investigate the proposed variables on special population.

In the proposed assessment protocol we can only partially test and validate the proposed theoretical model, especially because the proposed sample of participants consist of individuals that have only autism spectrum traits and not a autism diagnosis. We consider this step to be an intermediate and a necessary one for the validation of the theoretical model, considering the difficulties that may arise when testing individuals with a diagnosis using sophisticated technological tools. Another possible constrain that needs to be considered is the fact that the reading comprehension may not be affected by the autism spectrum traits as it is in the case of a diagnosis of ASD. Accordingly we will consider reading comprehension only from the perspective of visual patterns in reading social vs. non-social information in the absence of deficits in the reading ability (which will be the case for our participants). Future studies are needed to be implemented in order to verify our model that should involve individuals that have a ASD diagnosis.

The understanding of social and attention deficits in individuals with ASD is important not only for the diagnosis process but also can document the development and implementation of suitable interventions. The use of eye-tracking methodology offers us the possibility to look into every moment of the information selection and has a great potential to inform our understanding of cognitive processing in individuals with ASD (Nelson, 2012).

Regarding the practical implications of our work, we consider that the findings from this research could help the practitioners to increase the effectiveness of SS or other techniques that are based on written social scenarios. By analysing the visual patterns of individuals with high autism spectrum traits or with a diagnosis with ASD in reading a social text we may extract relevant features regarding the way they process the information which may lead us to improving or modifying the way we present them the texts.

The use of technological tools in special education appears to bring more light in terms of diagnosis, underlying mechanism and interventions. These findings may impact daily activities of children with special needs and can increase accessibility of evidence based-interventions for them and help to identify the best teaching methodologies for better inclusion these children in the general education.

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Phytoextraction potential of wheat and study on the applicable ratio of converter sludge in some soil-sludge mixtures

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Abstract

Converter sludge is a by-product of the "steel industry", at the wet cleaning process of the converter gas. The sludge might contain heavy metal oxides, more particularly of lead- (Pb) and zinc (Zn) oxides. Our aim is to investigate the accumulation ratio of these components within the different parts of some selected plants during the potential phytoremediation, phytoextraction processes. The investigation was implemented with the collaboration of students, who gained practical knowledge in sample preparation, analysis and data evaluation. The gained knowledge is a good complement to what the students have been learned in higher education and provides useful practical insights into environmental analysis. For the preparation of the laboratory experiment of this research, we made seedling growth tests with white mustard (*Sinapis alba*) seeds on the 20-40-60-80% mixtures of converter sludge and different kinds of soils. According to the germination results we determined that the most capable mixtures were the converter sludge and the loess mixtures. Wheat *(Triticum aestivum)* was chosen as a test plant for the experiments. The mixing ratio of the converter sludge was 5-10-15-20-25%. The metal content of the sludge-soil mixtures and the different parts of the wheat plants (shoot, root) were analyzed by XRF instrument. The results showed that the most effective and tolerable ratio of converter sludge can be the 10 and 15% in loamy soil mixtures. Wheat plants seem to be applicable on decreasing of the metal content from the sludge-soil mixtures. The decreasing average ratio was 50 % for Pb, 53 % for Zn, at using the lowest applied ratio into the soils. Further aim is to find other potential industrial plants for decreasing of the ratio toxic elements from the converter sludge.

Keywords: converter sludge; industrial plants; bioremediation-phytoextraction

1. Introduction

Industrial production of steel industry and the increasing population can have adverse effects on environmental quality (*Biró, Szegi 1994*). During the applied industrial processes many types of by-products, sludges and slags are produced, which contain metal oxides, or potentially toxic elements (PTE), which might become "heavy metals" in supra-optimal doses in the soil-plant-ecosystems (*Mikanová et al. 2001*). Within these metals, some of them (e.g.

cadmium, Cd and lead, Pb) might become especially toxic, due to the fact that they can have no or only weak vital roles (*Vivas et al. 2003a, b, 2005*). At some cases, e.g. at the rare-earth metals and at the nickel (Ni), there are great efforts for reusing them in the so-called "phytomining" processes. It is potentially applicable if their concentration in the plant tissues can reach the 1% ratio, at least, to become economically feasible.

During the proposed research results the "converter sludge" of steal industry was selected from the so-called "industrial sludges" for the laboratory experiments.

The converter sludge was produced in the steel making process of ISD-Dunaferr Ltd. The company is using converter for making steel among some other (i.e. open-hearth steelmaking and electric steelmaking) technological solutions. During the operation of the converter, high pressure of oxygen is blown into the liquid metal, which results that CO gases and semi-metallic elements will be observed in the final sludge. At the end of the process, wet dust removal system is applied. Because of it, converter sludge contains a high concentration of ZnO, PbO and some other organic substances *(Yaozu et al., 2020)*. The zinc concentration in the sludge of ISD-Dunaferr Ltd. is between 0,67-3,95%, the Pb content is about 0,2-0,4%. Produced quantity of the sludge is around 30.000 tons/year, with the maximum Zn content is around 1185 tons/year *(Márkus et al., 2011)*.

Zinc (Zn) and lead (Pb) can become toxic in the environment and are known to have a great bio-accumulation potential in the environment, and also in the soil-plant-animal-human food-chain (*Vivas et al. 2005*). Zinc is known as one of the "essential" elements, but in high, "supraoptimal" concentration it can result several disorders in human health, i.e. lethargy, focal neuronal deficits, respiratory disorders, metal fume fever, nausea and might elevate the risk for cancer *(Laura, 2010)*. Lead also might result health problems in adults, but more seriously in children. Lead (Pb) is accumulating within the human body in the bones and in teeth. It can increase the risk of high blood pressure and kidney damage (*Vivas et al. 2003b*). In pregnant women Pb can result miscarriage, stillbirth, premature birth and low birth weight. In case of children, the high lead exposure might result problems in the brain and in central nervous systems, and become more seriously as coma, convulsions and even death *(WHO, 2019)*.

There are many chemical, physical and biological methods for reducing the metal content and the toxicity even of the various industrial sludge-types. Between the already known and suggested methods, the phytoextraction is applied in a world-wide ration (*Biro et al. 2005*).

The technology is relatively non-expensive, and it is offer of the potential of reducing the hazardous element-content in the soils. During the phytoremediation techniques the environmentally hazardous chemicals are taken up by the plants (mainly industrial ones), so the elements will not going further and the accumulation is avoiding of the foods. The used plants can have an increased biomass-production, which might be used for the energy (heat, electricity) production. Furthermore, plants can absorb the CO_2 content of the air, which is very important in reduction of greenhouse effect.

During the laboratory experiments, presented in this study, university students were also participating. This is part of our teaching activities, so as to provide applied research-industrial experiences. As it is shown in the presented work, students can become acquainted in significant methodologies (i.e, in collecting and preparation of samples, in environmental analyses methods and properly evaluating of scientific results. Our aim is to improve their practical knowledge on the field of soil protection, phytoremediation, as well as on the recovery of energy resources. Furthermore, we try to develop their sensitivity for the environmental protection and develop their global environmental way of thinking.

2. Methods

2.1. Seedling growth test

The white mustard seeds (*Sinapis alba*) as test plants were used, according to MSZ 21 976-17:1993 Hungarian standard.

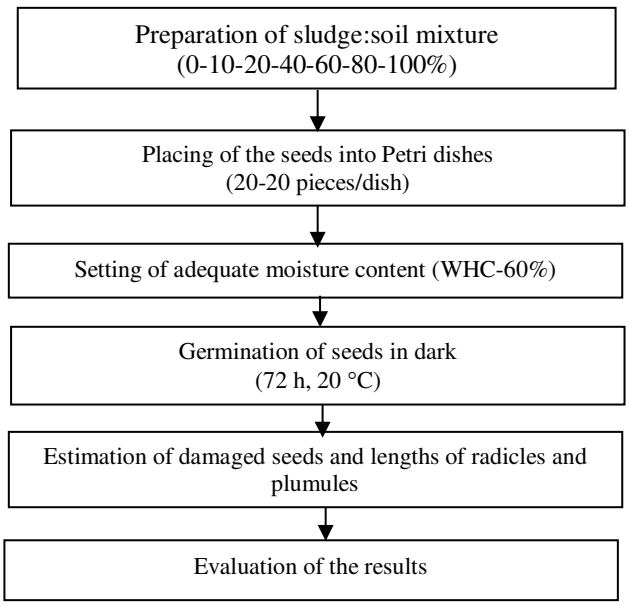

Fig. 1. Steps of the seedling growth test with mustard (*Sinapis alba*).

Regarding the experiments, dried converter sludge, mixed with four different soils were used in Petri dishes; the ratio of sludge was 20-, 40-, 60-, 80 and 100 %. In each Petri dish 20 seeds of the white mustard were put onto the surface of soil: sludge mixture, watered by the 60% of total water-holding capacity. Experiment were done in three replicates. The main steps of the seedling growth test can be seen in Figure 1.

Considering the accumulation of the toxic metals in different parts of the test plants, the bioaccumulation-bioconcentration-translocation factors were calculated.

Bioaccumulation factor (BAF)

BAF is the ratio of metal concentration in the plant shoots to the used sludge:soil mixtures.

$$BAF = C_{shoots}/C_{sludge}$$

where C_{shoots} is the metal concentration in the plant (plumules of seedling) and C_{sludge} as metal concentrations in the sludge:soil mixtures. The BAF factor of the known hyper-accumulator plants are generally greater than 1 *(Lago-Vila et al. 2015).*

Bioconcentration factor (BCF)

BCF is the ratio of the metal contentration in every plant parts and in the sludge:soil mixtures.

$$BCF = C_{plant\ parts}/C_{sludge}$$

where $C_{plant\ part}$ is the metal concentration of the whole plants (plumules and radicles) and C_{sludge} is the metal concentrations of the sludge:soil mixtures

Translocation factor (TF)

TF is the ratio between the metal content (ppm) in shoot of the test plant (C_{shoots}) to the roots (C_{roots}).

$$TF = C_{plant\ parts\ above\ the\ surface} / C_{roots}$$

when TF > 1, then it shows, that the metals were translocated from roots to shoots efficiently *(Baker and Brooks, 1989; Lago-Vila et al. 2015).*

The metal concentration in sludge:soil mixtures and the dried plants samples were analysed with XRF (X-ray flouroscence) instrument. It is widely used, because this equipment belongs to the non-destructive chemical analyses of minerals, alloys, sediments and soils. Each sample were measured in 3 replicates, assessment time was 30 sec.

3. Results

3.1. Results of industrial sludge:soil mixtures

Regarding the seedling growth tests, prepared by mixtures of converter sludge and the soils, four representative soil-types were selected for the experiments: S1 - "acidic brown forest soil" of Sopron mountain, S2 - sandy-loamy "chernozem soil" and S3 - "loamy" soil nearby of Dunaújváros, S4 - slightly "saline soil" from the Kiskunság region, Hungary.

The mixing ratio of the sludge was used, as 20-, 40-, 60-, 80- and 100%. We also made this test on 100% soils as controls. Among the used soils, the acidic brown forest soil had the lowest pH value (pH=4.5) (Fig. 2.).

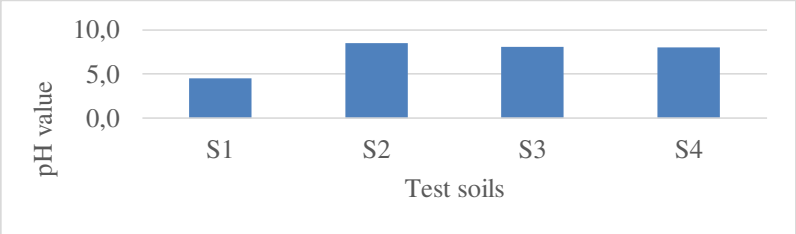

Fig.2. The pH values of the test soils

Among the mixtures of the converter sludge and the four soils, loamy (S3) and chernozem (S2) soils showed the best germination results. When these soils were mixed to converter sludge, the ratio of the pullulated seeds were higher (Fig. 3.) at the 20 and 40% mixtures. Longer radicles and plumules were observed in these mixtures (Fig. 4.). When we compared the controls to their 20% mixtures with converter sludge, it can be determined that the presence of the sludge could stimulate the growing of the seeds *(Kovács-Bokor et al, 2019)*.

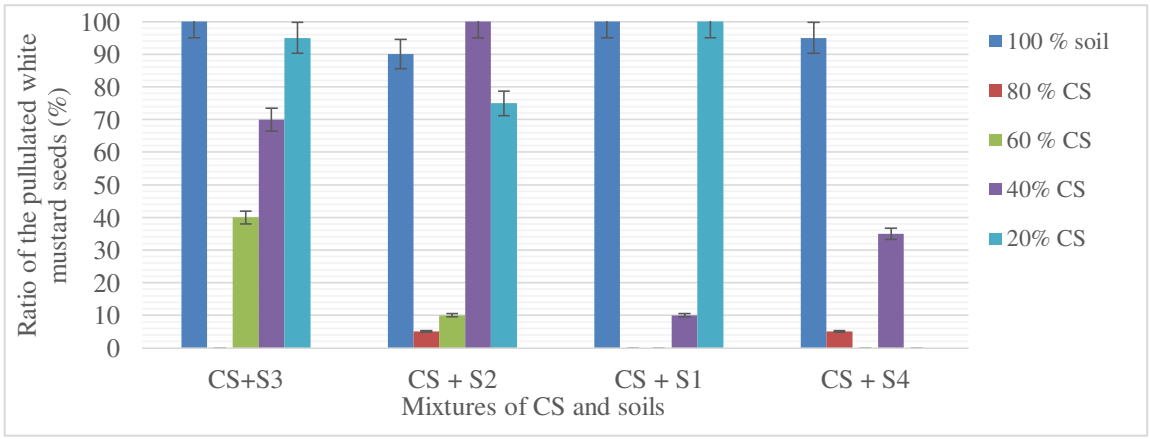

Fig. 3. The ratio of the pullulated seeds on the mixtures of converter sludge and soils

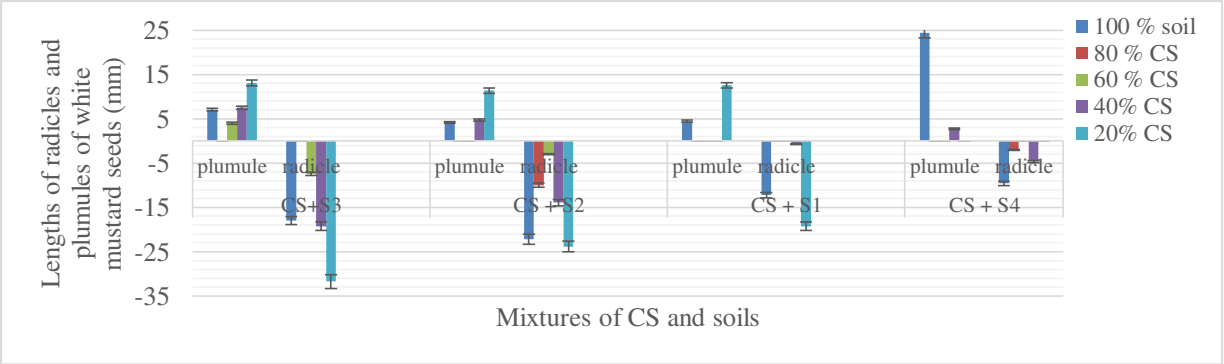

Fig. 4. The length of radicles and plumules on the mixtures of converter sludge (CS) and soils

3.2. Metal concentrations in sludge:soil mixtures and in wheat seedlings

According to the results of the seedling growth test, converter sludge (CS) and S3 - "loamy" soil were used as the sludge:soil mixture.

3.2.1. The Cd concentration

Based on Figure 5. the Cd content of the sludge-soils samples exceeded the Hungarian standard levels, which is 1 mg/kg *(KvVM-EüM-FVM Regulation No 6/2009)*. When the final result of the metal concentration was compared to the beginning state, Cd content of the 10 and 15% sludge-soil mixtures decreased.

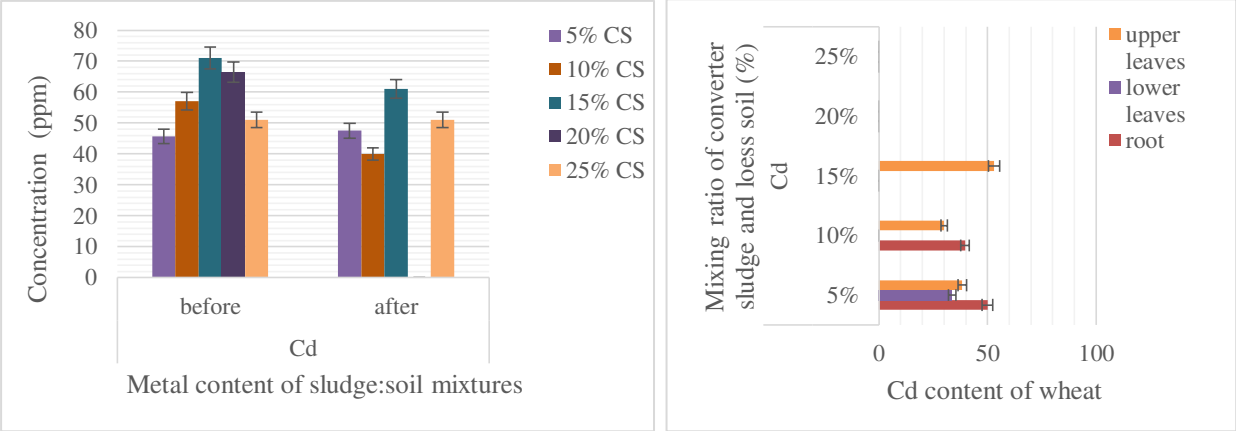

Fig. 5. Cd content of the soil-sludge mixtures and the plant-parts of the wheat

Higher Cd concentration was detected mainly in the roots of wheat samples (Fig. 5.). In the case of the 5% and 10% mixtures could accumulate this toxic element into the higher part (lower and upper leaves) of the test plant. The cadmium concentration was higher in the test plants than the permissible Hungarian limit of 0.5 mg/kg *(Simon 2006, Szegedi 2011)*.

3.2.2. The Pb concentration

The Hungarian standard level for Pb content is 100 mg/kg *(KvVM-EüM-FVM Regulation No 6/2009)*. According to the Figure 6, the Pb content of the mixtures was higher than this limit value. Lead content decreased as a result of the phytoextraction experiment in each mixture.

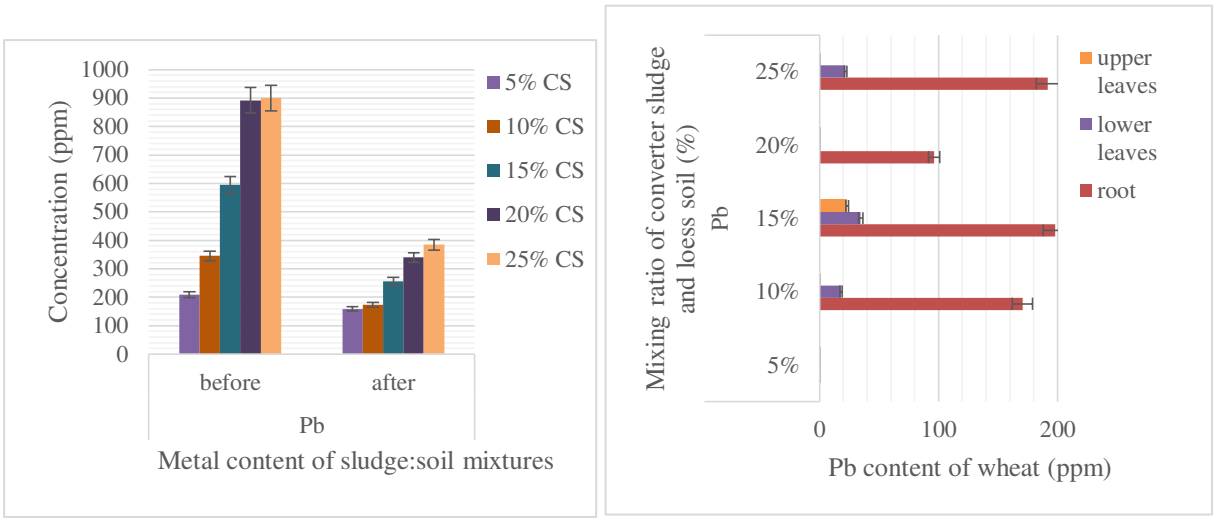

Fig. 6. Pb content of the soil-sludge mixtures and the main parts of the wheat samples

The leaves of the test plant could not accumulate lead in higher quantity in comparison with root samples (Fig.6.). Among the mixtures, 15% mixing ratio was the most effective, because in this case lead could translocated from the roots to the leaves. The accumulated lead concentration was within the permissible Hungarian limit, which is between 30-300 mg/kg *(Simon 2006, Szegedi 2011)*.

3.3.3. The Cu concentration

Copper (Cu) belongs to the group of, so called "essential elements". Based on the Figure 7, the Cu concentration of the sludge-soil mixtures was under the Hungarian standard limit of 75 mg/kg *(KvVM-EüM-FVM Regulation No 6/2009)*. According to the results, the quantity of copper decreased in the samples, but further experiments are needed for it, because this element could not be observed in the test plants.

The test plant was not able to accumulate copper (Fig. 6.). Comparing the roots and the leaves of the wheats, roots contained Cu in higher levels at the 10 and 15% mixtures. The Cu contamination of the samples was above the Hungarian preferable limit value of 35 mg/kg *(Simon 2006, Szegedi 2011)*.

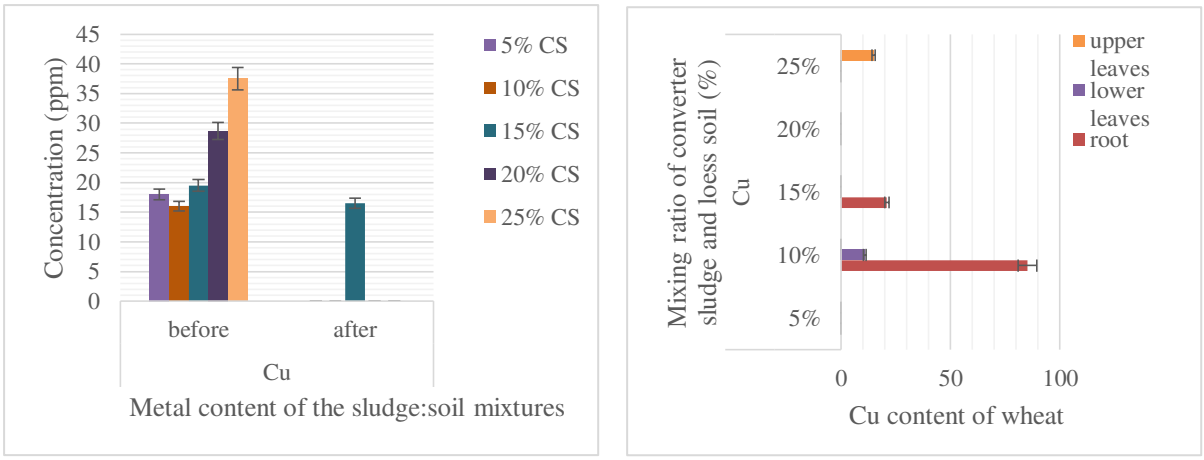

Fig. 7. Cu content of the soil-sludge mixtures and the main parts of the wheat samples

3.2.4. The Zn concentration

Zinc (Zn) is also belongs to the group of the "essential elements". Based on the Fig. 8., the Zn concentration of the sludge-soil mixtures decreased. The Zn content of the mixtures exceeded the Hungarian standard limit, which is 200 mg/kg *(KvVM-EüM-FVM Regulation No 6/2009).*

Higher Zn content was mainly detected from the roots of the test plant. The efficiency of the accumulation was higher at 10, 15 and 25% mixtures, because Zn could translocate from roots to leaves in higher rate from these mixtures. The Zn concentration of the roots exceeded the tolerable value, which is 250 mg/kg *(Simon 2006, Szegedi 2011).*

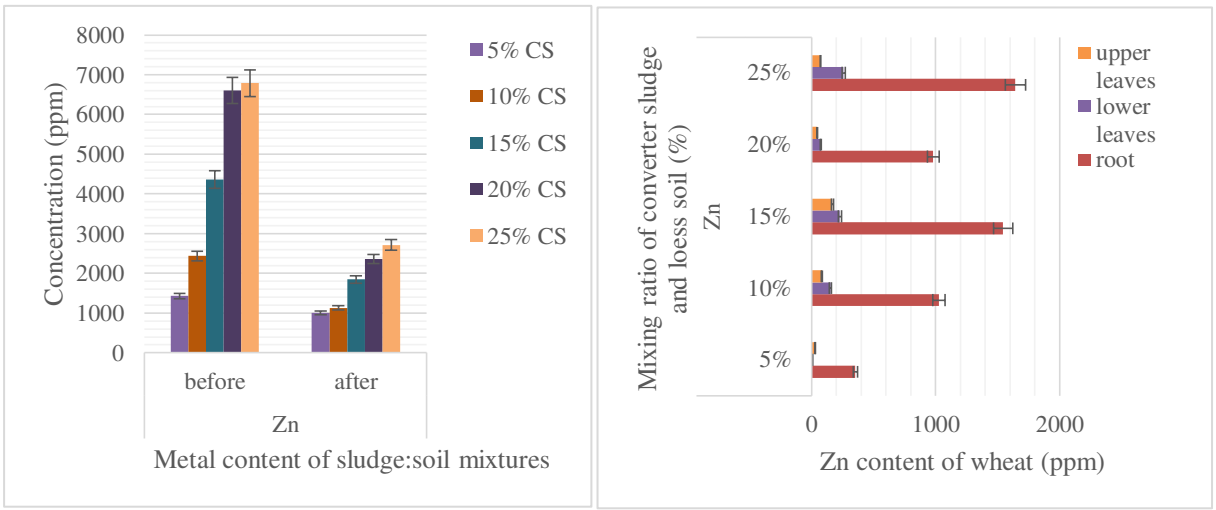

Fig. 8. Zn content of the soil-sludge mixtures and the main parts of the wheat samples

3.2.5. The Mn concentration

Based on the Figure 9, manganese concentration of the sludge-soil mixtures decreased up till the end of the experiment.

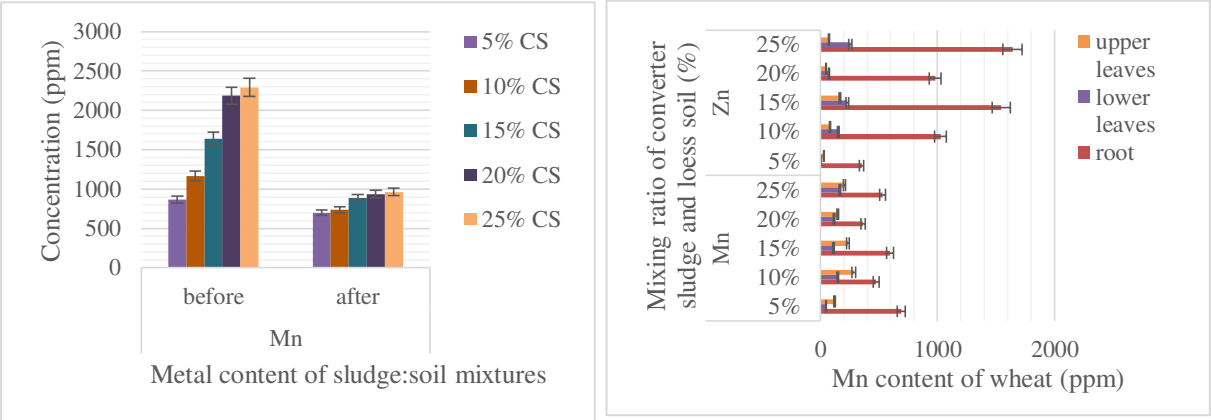

Fig. 9. Mn content of the soil-sludge mixtures and the main parts of the wheat samples

Mn accumulation was more effective than Zn accumulation. Mn content was also mainly detected from the roots of the test plant, but at every mixtures Mn could translocate from the roots to the higher parts (leaves) of the wheat in higher rate.

3.2.6. The Fe concentration

Based on the Figure 10, iron (Fe) concentration of the sludge-soil mixtures also decreased, due to the bioaccumulation by the wheat plants.

Fe accumulation was very similar to the Mn accumulation. The highest concentrations were detected from the roots, but the plant could accumulate this element into the shoots. The Fe can be translocating within the test plants very easily.

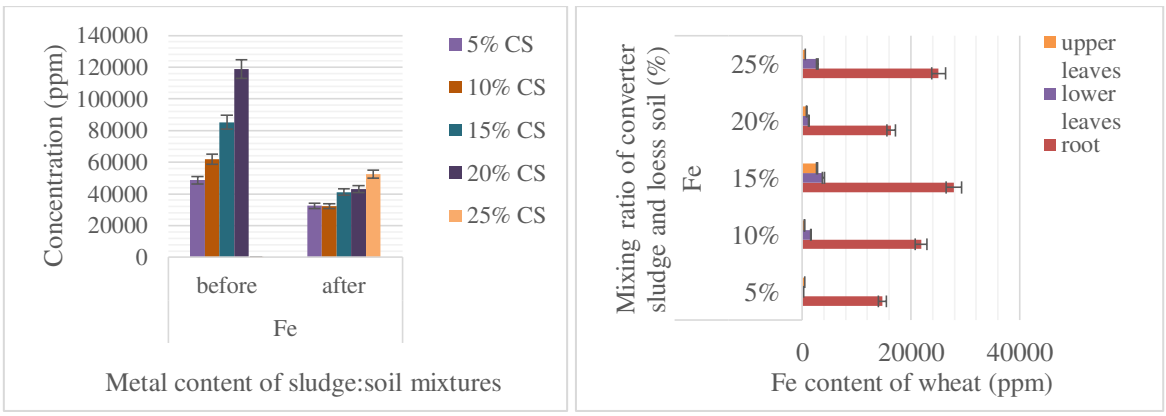

Fig. 10. Fe content of the soil-sludge mixtures and the main parts of the wheat samples

3.3. Bioaccumulation, bioconcentration and translocation factors in wheat

The bioaccumulation factor (BAF) for Cd, Pb, Zn, Cu, Fe and Mn was generally less, than 1, only the BAF factor of Cd was higher than >1 in the case of the 5-10-15% sludge-soil mixtures (Fig.11.). The trend of BAF for toxic metals was in the order of Cd>Mn>Zn>Fe>Pb>Cu.

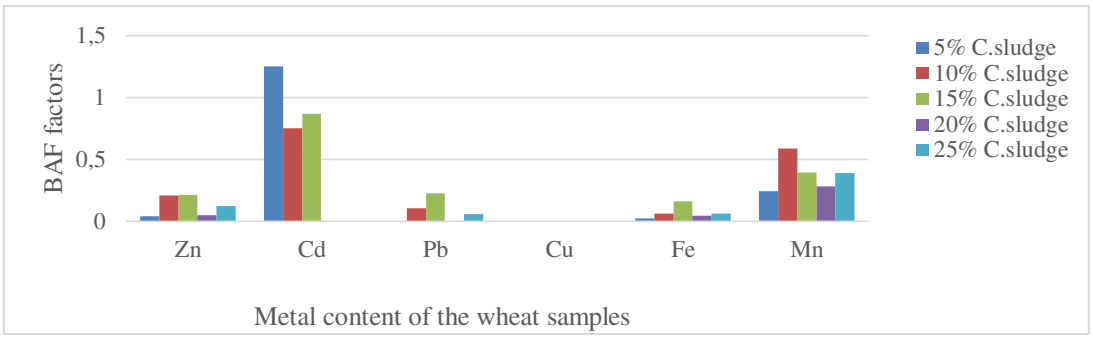

Fig. 11. Bioaccumulation factor (BAF) of some studied elements in wheat samples

In the case of bioconcentration factor, the values were below 1. Between the main parts of the wheat plant (roots, leaves), roots could accumulate the measured metals in higher ratio (Fig. 12.)

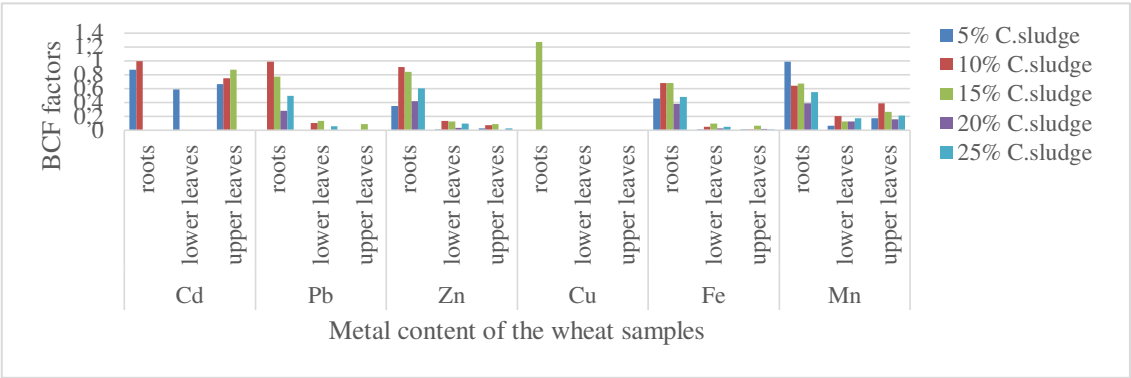

Fig. 12. Bioconcentration factor (BCF) of wheat samples

The TF factor for every element was <1 (Fig. 13.). This result showed that in wheat samples the metals were not translocated effectively, from the roots to the leaves *(Baker- Brooks 1989; Lago-Vila et al. 2015).* The order of TF factors is: Cd>Mn>Zn>Fe>Pb>Cu.

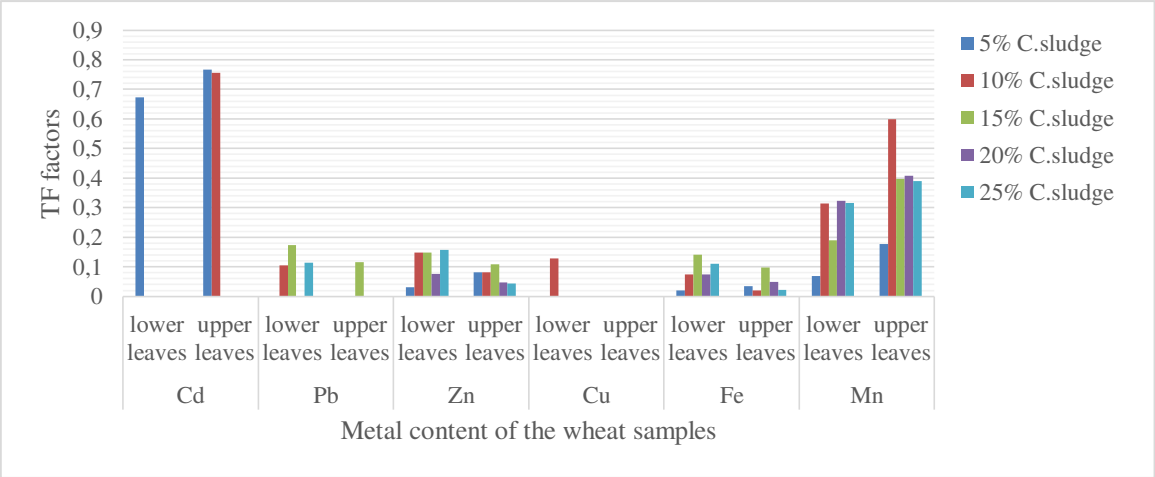

Fig. 13. Translocation factor (TF) of wheat samples

4. Conclusions

The metal concentration in the sludge:soil mixtures was measured before and after the phytoextraction experiment. The Cd, Pb and Zn content of the mixtures were above the Hungarian standard limits. Wheat had a positive effect on the concentration of the metals. Metal content of the mixtures decreased at the end of the experiments. The average quantity of the heavy metals of the soil:sludge mixtures was found to be decreased by wheat. The average decreasing ratio was 53% for Zn, 50% for Pb and 44% for Mn.

The metal content of the wheat samples was also analysed. The wheat samples could accumulate these metal elements in higher ratio, except of Cd and Cu. BAF, BCF and TF factor for Cd, Pb, Cu, Zn, Mn and Fe were mainly <1. The BCF of the roots was around 1 in the case of Cd, Pb, Zn and Mn. According to these results, roots could accumulate the measured elements in higher ratio than the shoots. The most effective sludge-soil mixtures were 10 and 15%. The trend of BAF and TF for heavy metals was in the order of Cd>Mn>Zn>Fe>Pb>Cu. Because the TF factor was <1 for every element, wheat could not translocate the toxic metals, in comparison with the hyperaccumulator plants. Further research is needed to find other adequate test-plants and soils with higher phytoextraction efficiency.

It is very important to mention, that students were participating in the experiments. They could be able to involve in the laboratory work, included in learning of the main assessment methods and it was a great facility of developing of their critical evaluation capacity. The potential use of up to date analytical methods was also learned, regarding the proper environmental protection.

5. Acknowledgements

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Analysis of JPEG Digital Image Compression Process

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Abstract

JPEG is the most often used image compression standard that is used since 1992. It is a lossy compression method, and is widely used in digital cameras and mobile phones. Depending on the parameters and user needs, it can achieve a compression ratio between 10 and 50. Memory for digital image storage is saved on the expense of decompressed image quality. The method is based on the Discrete Cosine Transform (DCT) that separates the image into different frequency components. This paper shows how different parameters of the algorithm influence the performance of the compression. In the end, ideas are given how to either increase the compression ratio keeping the same decompressed image quality, or to improve the quality without decreasing the compression ratio. The quality between the original and the decompressed images is measured using two objective criteria: the Peak Signal-to-Noise Ratio (PSNR) and the structural similarity index (SSIM). Different types of 8x8 image blocks (flat, impulse, ramp, ...) and their DCT transforms are analysed so the reader can anticipate the frequency content of the blocks. Understanding of the frequency content helps in creating customized algorithms for improving the basic JPEG.

Keywords: digital image compression, JPEG, quantization

1. Introduction

Digital image compression is an important operation to save memory space when storing digital images or videos. Compression algorithms take advantage of the presence of redundant data in digital images and reduce them. The point of the compression is to eliminate the redundancy without losing information from the image. Compression methods can be divided into two main categories: 1/ lossless, where the original image can be restored without any loss, and 2/ lossy, where the reconstructed image is only the approximation of the original. Current standards allow compression ratios around 1:3 for the lossless case and between 1:10 and 1:50 for the lossy case.

The importance of digital image compression can be shown with the following example. For a 512x512 pixel 8-bit single colour digital image, the memory needed to store the image is

768kB. One minute of full HD 1080x1920 pixel resolution video with 30 frames per second would need around 12GB of storage space, so the importance of compression is obvious.

This paper focuses on the most widely used digital image compression standard - the JPEG algorithm, which is based on the discrete cosine transform. Since this transform is well documented and used since 1974 (Pennebakker, Mitchell, 1992; JPEG group, 1992; Ahmed, Natarajan, Rao, 1974), it will not be explained in detail. A typical 256x256 pixel digital image that without compression occupies 64kB of memory space is shown in Fig. 1(a). Figures 1(b), 1(c) and 1(d) show the same image with different levels of compression. Image sizes are listed below. As it can be observed, compression ratio of 10 can be easily achieved without noticeable loss in quality. For higher compression ratios (lower bitrate) the degradation in decompressed image becomes visible. The intensity of the degradation can be controlled with quantization that will be explained in the next section.

(a) (b) (c) (d)

Fig. 1. Test image Lena with different compression ratios. (a) Original Lena image, Size: 64kB, bitrate: 8bpp, (b) Lena test image compressed with compression ratio 11, Size: 5.8kB, bitrate: 0.73bpp, (c) Lena test image compressed with compression ratio 30, Size: 2.1kB, bitrate: 0.27bpp, (d) test image Lena compressed with compression ratio 46. Size: 1.4kB, bitrate: 0.17bpp.

2. The JPEG process

The JPEG algorithm starts by dividing the digital image into blocks of size NxN. The size of the block can be different, where N usually equals 8. Other block sizes are possible, but rarely used. The same sequence of steps is then performed on each block. First, the original image range is shifted from [0, 255] to [-128, 127] by subtracting 128 from each entry of the 8x8 block. This step is followed by the discrete cosine transform (DCT) of the block and this is the core of the JPEG compression algorithm. The DCT compacts the energy of the block into only few coefficients(Wallace, 1992). So, the block of 8x8 pixels is transformed into a block of 8x8 coefficients that represent the frequency components of the block. The upper left value is the DC component, and it represents the average value of the block, the remaining 63

values in the transformed block are the AC components and they represent the frequencies from low to high. The basic idea behind compression is to preserve the DC and the low frequency coefficients, and to ignore the high frequency coefficients, since the human eye will not be capable to recognize the degradation. The operation that will zero out the high frequency components is quantization. The trick is to find the optimal measure of degradation that will not be visible for the human eye, since JPEG is optimized for humans.

2.1. Discrete Cosine Transform (DCT)

The Discrete Cosine Transform converts the NxN matrix into another NxN matrix. In the case of digital image processing, these matrices represent digital images. The formulas for the forward and inverse transformations are given in Eq. (1).

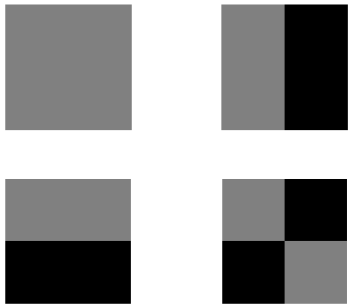
$$C(u,v)=\alpha(u)\alpha(v)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1} f(x,y)\cdot\cos\left[\frac{(2x+1)u\pi}{2N}\right]\cdot\cos\left[\frac{(2y+1)v\pi}{2N}\right]$$

$$f(x,y)=\sum_{u=0}^{N-1}\sum_{v=0}^{N-1}\alpha(u)\alpha(v)C(u,v)\cdot\cos\left[\frac{(2x+1)u\pi}{2N}\right]\cdot\cos\left[\frac{(2y+1)v\pi}{2N}\right] \quad (1)$$

$$\alpha(u)=\begin{cases}\sqrt{1/N} & \text{for } u=0\\ \sqrt{2/N} & \text{for } u=1,2,...,N-1\end{cases}$$

As it can be seen, the core of the transform is the cosine function. The original matrix is decomposed into its frequency components using the cosine function. The transformation is real, there is no imaginary part as in the Fourier transform. The 2-D DCT is also separable, so it can be obtained by two subsequent 1-D DCTs. The 2x2 basis functions for the 2-D DCT along with their numeric values are shown in Fig. 2. For example, a 2D-DCT transform of the 2x2 matrix $M=\begin{bmatrix}3 & -7\\ 8 & 6\end{bmatrix}$ is a 2x2 matrix $MDCT=\begin{bmatrix}5 & 6\\ -9 & 4\end{bmatrix}$. It means that matrix M can be obtained from the four basis function using Eq. (2). 4x4 and 8x8 blocks are decomposed in similar way using 16 and 64 basis functions, respectively.

$$5\cdot\begin{bmatrix}0.5 & 0.5\\ 0.5 & 0.5\end{bmatrix}+6\cdot\begin{bmatrix}0.5 & -0.5\\ 0.5 & -0.5\end{bmatrix}-9\cdot\begin{bmatrix}0.5 & 0.5\\ -0.5 & -0.5\end{bmatrix}+4\cdot\begin{bmatrix}0.5 & -0.5\\ -0.5 & 0.5\end{bmatrix}=\begin{bmatrix}3 & -7\\ 8 & 6\end{bmatrix} \quad (2)$$



$$\begin{bmatrix} 0.5 & 0.5 \\ 0.5 & 0.5 \end{bmatrix} \quad \begin{bmatrix} 0.5 & -0.5 \\ 0.5 & -0.5 \end{bmatrix}$$

$$\begin{bmatrix} 0.5 & 0.5 \\ -0.5 & -0.5 \end{bmatrix} \quad \begin{bmatrix} 0.5 & -0.5 \\ -0.5 & 0.5 \end{bmatrix}$$

(a) (b)

Fig 2. (a) 2x2 basis functions, (b) Numeric values of the transform matrices

2.2 Quantization

Quantization is the operation that degrades the digital image in a controlled way. Quantization is done by dividing each transform coefficient by an appropriate value. Quantization can be uniform when all quantization matrix entries have the same value, and non-uniform when each component is quantized differently. Since the human eye has different sensitivity to different frequency components, usually the non-uniform type of quantization is preferred (Thai, Cogranne, Retraint, 2017). The standard Q_{50} quantization matrix that is used in many applications is shown in Fig. 3. Quantization with this matrix can achieve very high compression ratio, with excellent decompressed image quality. This quantization matrix was discovered experimentally by image processing experts who made subjective tests over many different digital images (Wang, Lee, Chang, 2001). Other quantization matrices can be derived from the Q_{50}. If the user needs higher quality, the Q_{50} should be multiplied by *(100-quality level)/50*. Higher quality also means more bits for representation and lower compression ratio. On the other hand, if the user wants to save extra bits and to sacrifice quality, the Q_{50} should be multiplied by *50/quality level*. The higher the index of matrix Q, the higher the quality, but the compression ratio also drops.

Two typical quantization matrices are shown in Fig. 3: the Q_{10} and the Q_{90}. By using the Q_{10} most of the coefficients will be zeroed out, and only few coefficients will remain. On the other hand, by using the Q_{90} whose entries are quite small, most of the frequency components will survive the quantization (Tan, Gan, 2015). Typical block of DCT coefficients quantized with different quantization matrices is shown in Fig. 4.

$$Q_{10} = \begin{bmatrix} 80 & 60 & 50 & 80 & 120 & 200 & 255 & 255 \\ 55 & 60 & 70 & 95 & 130 & 255 & 255 & 255 \\ 70 & 65 & 80 & 120 & 200 & 255 & 255 & 255 \\ 70 & 85 & 110 & 145 & 255 & 255 & 255 & 255 \\ 90 & 110 & 185 & 255 & 255 & 255 & 255 & 255 \\ 120 & 175 & 255 & 255 & 255 & 255 & 255 & 255 \\ 245 & 255 & 255 & 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 & 255 & 255 & 255 \end{bmatrix} \quad Q_{90} = \begin{bmatrix} 3 & 2 & 2 & 3 & 5 & 8 & 10 & 12 \\ 2 & 2 & 3 & 4 & 5 & 12 & 12 & 11 \\ 3 & 3 & 3 & 5 & 8 & 11 & 14 & 11 \\ 3 & 3 & 4 & 6 & 10 & 17 & 16 & 12 \\ 4 & 4 & 7 & 11 & 14 & 22 & 21 & 15 \\ 5 & 7 & 11 & 13 & 16 & 12 & 23 & 18 \\ 10 & 13 & 16 & 17 & 21 & 24 & 2 & 21 \\ 14 & 18 & 19 & 20 & 22 & 20 & 20 & 20 \end{bmatrix}$$

$$Q_{50} = \begin{bmatrix} 16 & 11 & 10 & 16 & 24 & 40 & 51 & 61 \\ 12 & 12 & 14 & 19 & 26 & 58 & 60 & 55 \\ 14 & 13 & 16 & 24 & 40 & 57 & 69 & 56 \\ 14 & 17 & 22 & 29 & 51 & 87 & 80 & 62 \\ 18 & 22 & 37 & 56 & 68 & 109 & 103 & 77 \\ 24 & 35 & 55 & 64 & 81 & 104 & 113 & 92 \\ 49 & 64 & 78 & 87 & 103 & 121 & 120 & 101 \\ 72 & 92 & 95 & 98 & 112 & 100 & 103 & 99 \end{bmatrix}$$

Fig. 3. Quantization matrices Q_{10}, Q_{50} and Q_{90}

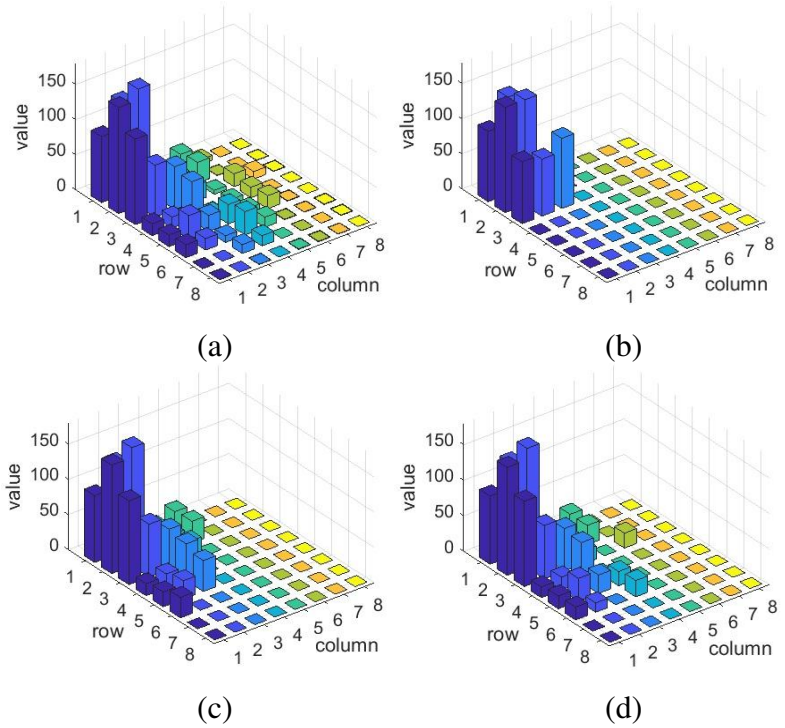
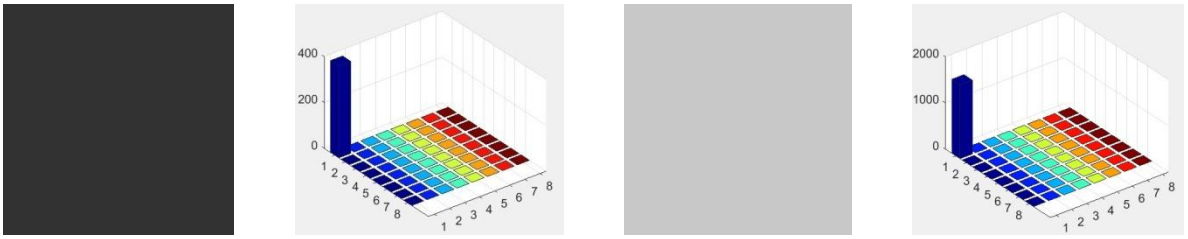


Fig. 4. (a) Original 8x8 block of DCT coefficients, (b) Quantized and dequantized block using quantization matrix Q_{10} – 7 coefficients remained, (c) Quantized and dequantized block using quantization matrix Q_{50} – 20 coefficients remained, (d) Quantized and dequantized block using quantization matrix Q_{90} – 25 coefficients remained

2.3. Block transforms

To get better insight what happens during the transformation of the *8x8*image block, typical blocks along with their transform are presented. The simplest block is a flat block where no variation in intensity is present inside the block, Fig. 5. The DCT of this block contains only

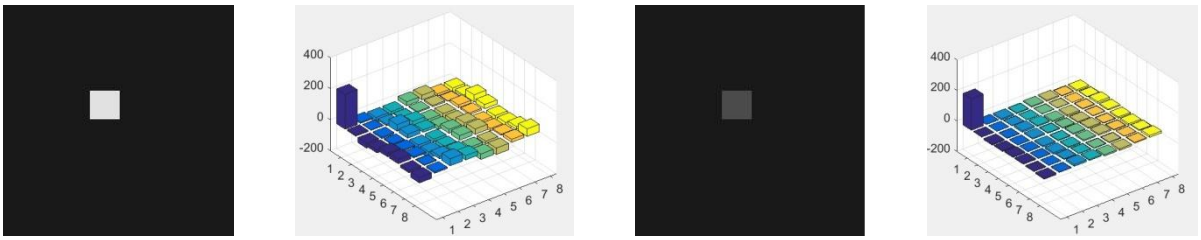
the DC component that represents the average value of the block, Fig. 5(b) and (d). The DC component of the darker block is smaller because the average intensity of the block is smaller.



(a) (b) (c) (d)

Fig.5. (a) Flat block, intensity 50, (b) DCT2 (a), (c) Flat block, intensity 200, (d) DCT2 of (c)

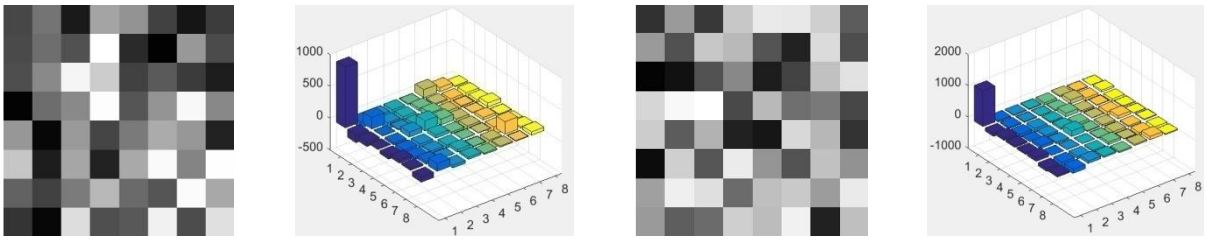
Fig. 6 shows a block that contains only one pixel impulse in the middle of the block. Transform of the block shows that horizontal, vertical and diagonal frequency components will appear. The intensity of these components depends on the contrast of the block to be transformed. Higher contrast will result in appearance of greater intensities of high frequency components. Fig. 6(a) shows a block with contrast 200 (intensity of the flat area is 25, and intensity of the impulse is 225). Fig. 6(c) also shows an impulse, but with a much lower contrast of 50 (intensity of the flat area is 25, and the intensity of the impulse is 75 as in the previous case). The difference in the frequency content is obvious. While both DC components are almost equal (225 and 206 respectively, the difference is caused by the different impulse intensity), AC components of the high contrast block are higher. The low contrast block more remind to the flat block, and this observation also holds for the frequency content.



(a) (b) (c) (d)

Fig. 6. (a) Impulse image block, contrast=200, (b) DCT2 of (a), (c) Impulse image block, contrast=50, (d) DCT2 of (c)

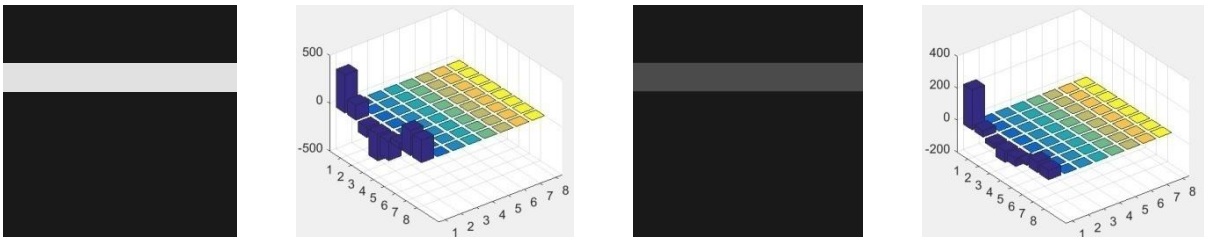
The next block analysed was a random texture block, Fig. 7. The block contains 64 random values between 0 and 255. The randomness of the block implies random frequency content for all spatial frequencies. The DC component that represents the average of the block will remain dominant in comparison with the other frequency components for both different random texture blocks.



(a) (b) (c) (d)

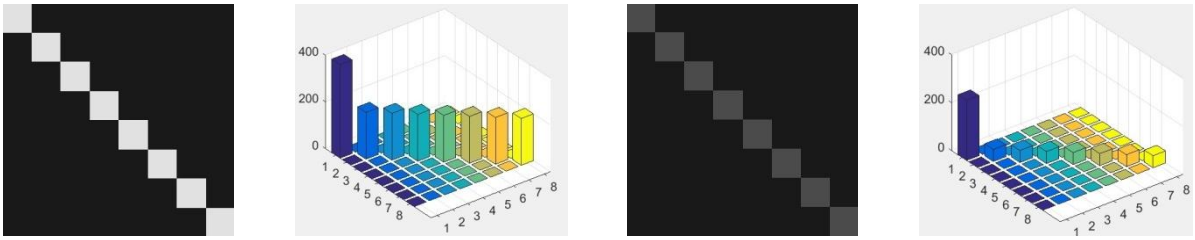
Fig. 7. (a) Random texture block 1, (b) DCT2 of (a), (c) random texture block 2, (d) DCT2 of (c)

The block that contains a horizontal line is shown in Fig. 8. Changes in intensity occur only in the vertical direction of the block, and that is the reason why only vertical frequency components are contained in the transformed image. The intensity of the transform coefficients also depends on the contrast between the line and the flat area. Higher contrast in the original block will result in higher intensities of the frequency components.



(a) (b) (c) (d)

Fig. 8. (a) High contrast horizontal line, (b) DCT2 of (a), (c) Low contrast horizontal line (d) DCT2 of (c)

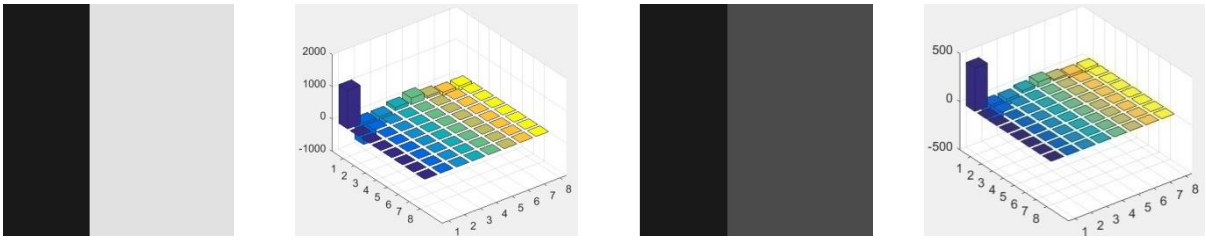


(a) (b) (c) (d)

Fig. 9. (a) High contrast diagonal line image block, (b) DCT2 of (a), (c) Low contrast diagonal line image block, (d) DCT2 of (c)

Next, the low contrast and high contrast diagonal line is analysed, Fig 9. After the transformation of both blocks, only the diagonal frequency components remained. This is because of the same change in both horizontal and vertical directions. Again, the intensity of the frequency components depends on the contrast between the line and the flat area of the block.

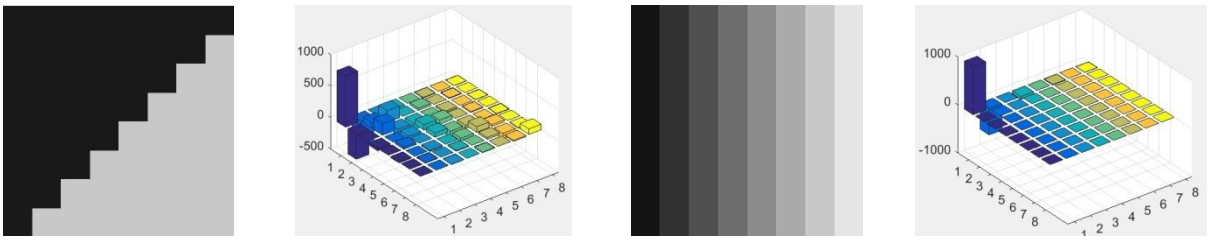
Fig. 10 shows the transformation of the low contrast and high contrast vertical edges. Both frequency plots show similar shape, dominant DC component and minor AC components. The DC component of the high contrast block is much bigger because the average value of the high contrast block is higher than the average value of the low contrast block.



(a) (b) (c) (d)

Fig. 10. (a) High contrast image block, (b) DCT2 of (a), (c) Low contrast image block, (d) DCT2 of (c)

Finally, Fig. 11 shows a diagonal edge and slope blocks before and after their corresponding DCT representations. Similarly as in the case of a diagonal line, the spectra of the diagonal edge contains only diagonal components. For the slope block where the intensity change occurs only in horizontal direction, the spectral components also appear in one direction (only the first row has entries different from zero).



(a) (b) (c) (d)

Fig. 11. (a) Diagonal edge image block, (b) DCT2 of (a), (c) Slope image block, (d) DCT2 of (c)

The above examples provide better insight into the nature of the transform. The important thing to remember is that the DC component represents the average of the block, and contains the highest portion of block energy. By moving further away from the DC component, frequency rises, and the energy of the components drops (Thyagarajan, 2011).

3. Experimental results

Thumbnails of standard test images where our tests were performed on are shown in Fig. 12. Two objective measures were used to evaluate the quality of the compression process: peak signal-to-noise ratio (PSNR) and the structural similarity index (SSIM). Values obtained

express the PSNR and SSIM between the original image and the image after the compression and decompression processes. While the PSNR measures the difference between images on a pixel base, the SSIM measures the difference in image structure. The PSNR ranges between 0 and high values (in *dB*), and the SSIM ranges between 0 and 1. Higher values of both measures mean better quality. Table I shows the results for all test images compressed and decompressed using quantization matrix Q_{50}.

Fig.12. Test images used in the research: Baboon, Barbara, Boat, Cameraman, Clock, F16 (top row), Lake, Lena, Moon, Peppers and Pirate (bottom row)

Table 1. Compression parameters for 11 test images, CR is the Compression Ratio, PSNR is expressed in decibels (dB), and SSIM is the Structural Similarity Index

	Bitrate (bpp)	CR	PSNR	SSIM
Baboon	0.84	9.49	29.63	0.66
Barbara	0.89	8.99	33.52	0.86
Boat	0.94	8.49	31.96	0.81
Cameraman	0.77	10.36	31.57	0.59
Clock	0.58	13.91	34.95	0.56
F16	0.83	9.66	32.71	0.74
Lake	1.05	7.60	31.14	0.80
Lena	0.72	11.10	33.79	0.79
Moon	0.72	11.07	32.19	0.64
Peppers	0.77	10.33	34.29	0.82
Pirate	0.96	8.30	31.70	0.82

4. Discussion

This paper analysed the DCT of different types of 8x8 pixel image blocks. Depending on the block type, the frequency content in the transformed domain is also changing. By analysing the transformed blocks the reader can get a good estimate what to except after transforming real image blocks. This is important because the transformation is followed by quantization which is the irreversible step of the process. The decision which quantization matrix to use can be reached if the user knows what to expect after the transformation. Many improved JPEG algorithms exploit this property, and adapt the quantization step to the block content.

5. Conclusion

In this paper we have analysed the JPEG process, explained how the discrete cosine transform works, and how quantization degrades the image quality. We also showed how the compression process saves memory space for storing digital images. By doing the experiments with test images we showed what are the typical values for the quality measures. In the future, it is planned to find a connection between image content and compressed digital image quality to get higher compression ratio with no change in decompressed image quality.

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EMC Measurement with GTEM Cell

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Abstract

Abstract: Nowadays, electromagnetic compatibility plays an increasingly important role in the development of a new equipment. When developing, attention should not only be paid to how noisy the equipment itself is, but also to how immune it is to the noise coming from the surroundings. The purpose of this article is to present an instrument used in EMC measurement on a training model and evaluate the measured results according to the given standards. In the measurements a low noise power supply panel TPS54560EVM-515 by Texas Instruments was used to power a RF absorber and a GTEM cell. The obtained results clearly showed the advantages and disadvantages of the cell construction compared with other EMC measurement procedures.

Keywords: EMC; Electromagnetic compatibility; GTEM cell

1. Introduction

One of the crucial steps in developing a device is acquiring the EMC certification. This certification can be obtained from accredited laboratories using a variety of measurement procedures.

The simplest EMC measurement procedure is to perform an Open Area Test Site (OATS) (Herr, 2013). In this case, the obtained values can immediately be compared to the standards. A major disadvantage of this method is the environmental noise, since there is no absorbent surface in the test area, but in return, it is cheap to build (Kenneth, 2004).

Figure 1. Intel EMC test measurement (*www.intel.com/content/www/us/en/design/test-and-validate/platform-testing-services/electromagnetic-testing.html*)

Another method is the use of a completely or semi-echoic and electromagnetically shielded test chamber (anechoic chamber) (Hemming, 2002). Here, the test device is located in a closed or semi-open but shielded test chamber during the measurement. The great advantage of the measurement process is that there is no external noise from the environment, whereas the disadvantage is the high construction cost (Chung, 2015).

The third method uses a so-called GTEM or TEM cell (Weiss, 1991). In this method, the test device is placed in a specially crafted metal box and measured after it is sealed. Its great advantage is its small size and low price, but due to its size it can only accommodate much smaller devices (Streitwolf, 2007). It is worth mentioning that the bandwidth is smaller than the TEM cell. A major disadvantage is, when comparing it with other procedures, the correlation equation must be applied (Morgan, 2010), (Soo-Hyung, 2004).

1.1 The GTEM cell

The GTEM (Gigahertz Transversal Electromagnetic Mode) cell is suitable for measuring the radiation and immunity of electrical equipment to noise. The cell is part of a tapered, rectangular coaxial tube feed line in which the inner and outer conductors are of equal length.

Figure 2. GTEM Cell (*www.theemcshop.com/used-gtem-cells/1678-ets-lindgren-5407-gtem-test-cell.html*)

At the input end, the cell is equipped with a standard 50 ohm coaxial connector for connecting the measuring RF absorber. There are usually several more coaxial connectors on the side, one or more interference-protected electrical outlets, a door, as well as various ventilation openings and possibly a fan.

The imaginary cross section of the cell is shown in Figure 3:

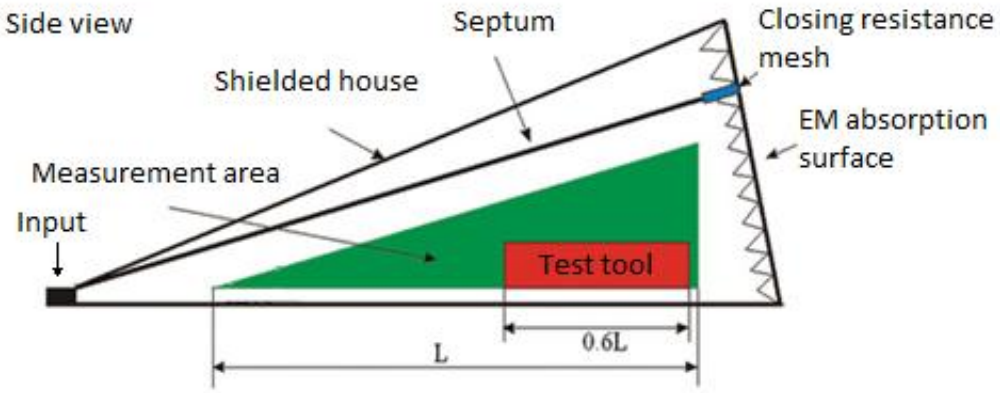

Figure 3. Structure of GTEM cell (by Patrik Elter)

The inside of the cell is non-reflective, which is achieved by an absorbent surface on the side opposite the apex. This surface consists of two layers. The first layer consists of ferrite tiles covering the entire side, while the second layer is made of conductive coated spikes.

Due to the absorption layer and the physical design, planar waves can be assumed in the cell with good approximation and the field strength decreases by 1/r from the input. In the cell, the antenna acts as the septum, a rectangular asymmetric conductor. One side of the septum has a coaxial connector and the other one has a resistance network. The function of the resistance network in the septum is to ensure uniform current distribution and 50 ohm impedance.

Since the test area, located in the midsection of the cell (indicated as the green area in Figure 3), can be regarded as a plane capacitor with good approximation, i.e. the electric field is homogeneous in that range, the nominal field strength can be calculated as follows:

$$E = \frac{U_{internal} - U_{external}}{h} \quad (1)$$

Where: $U_{internal}$ voltage

$U_{external}$ voltage

h distance between lower shell and inner conductor.

The input power P required for immunity testing can be determined using the voltage U and the impedance $Z_0 = 50\ \Omega$, thus it is not necessary to know value of the current:

$$P = \frac{U^2}{Z_0} \quad (2)$$

Thus, the required input power at the h height of the cell is:

$$P_h = \frac{(E \cdot h)^2}{Z_0} \quad (3)$$

For emission measurement, it is necessary to know the position of the device being measured within the cell. For this purpose, the cell has a computer-controlled manipulator that can be used to change the position of the device.

In order to be able to compare the values measured with the GTEM cell using another EMC measurement method, the emission must be measured in three positions:

- pointing towards the pointed half of the cell (z),
- upward direction (y),
- to the right of the cell (x).

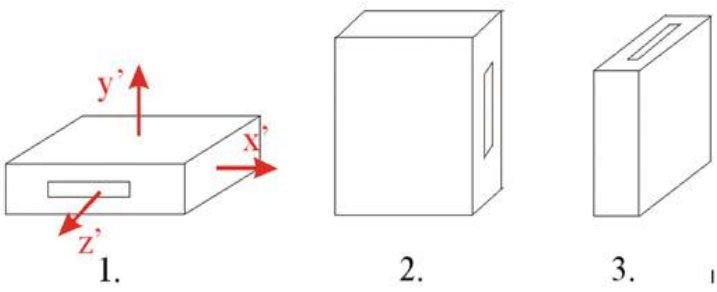

Figure 4. Different measuring positions of the device to be measured (*http://www.compliance-club.com/archive/old_archive/030317.htm*)

Multiple positioning points (EUTs) can be added for measurement along the z-axis, such as 6, 9, and 12, so as to fine-tune the measurement. In such a case, the conversion to other measurement methods, e.g. OATS, changes.

The radiated power of a measured device can be calculated from three measured values:

$$P = \frac{\eta}{3\pi} \cdot \frac{k^2}{e^2 Z_c} S^2 \, [W] \tag{4}$$

Where:

$$S \, [V] = \sqrt{V_X^2 + V_Y^2 + V_Z^2} \tag{5}$$

$$S \, [V|_{dB} \, dB(\mu V)] = \sqrt{10^{\frac{V_X|_{dB}-120}{10}} + 10^{\frac{V_Y|_{dB}-120}{10}} + 10^{\frac{V_Z|_{dB}-120}{10}}} \tag{6}$$

$$k = \frac{2\pi}{\lambda} \tag{7}$$

$$\eta = \sqrt{\frac{\mu}{\varepsilon}} \cong 377\Omega \tag{8}$$

- V_X, V_Y, V_Z: voltages measured at different EUT positions,
- S: squared sum of the measured voltages,
- k: wave number 1 / m (wave number),
- η: the impedance of the air,
- Zc: impedance of the cell,
- e: cell TEM field factor in $\frac{\sqrt{\Omega}}{m}$.

The GTEM cell field factor can be determined analytically and experimentally (standard).

1.2 Conversion to open field EMC (OATS) measurement

Most of the EMC standards used in the industry have OATS limits (standard), therefore the measured values of the GTEM cell need to be converted to this measurement method (Soo-Hyung, 2004). The correlation equation below is implemented for conversion.

1.1.1. Correlation equation:

$$E_{max} = g_{max} \cdot \sqrt{\frac{D_{max}\eta}{4\pi} P} \tag{9}$$

$$E_{max} = g_{max} \cdot \frac{\eta \cdot k}{2 \cdot \pi \cdot e} \cdot \frac{s}{\sqrt{Z}} \tag{10}$$

gmax: The antenna geometry for horizontal (Formula 9) and Vertical (Formula 10) polarization.

Dmax: maximum antenna orientation, which varies from chamber to chamber with worst case value 3.

$$g_{max} = \begin{Bmatrix} \left|\frac{e^{j\cdot k\cdot r1}}{r_1} - \frac{e^{j\cdot k\cdot r1}}{r_1}\right|_{max} = \left|\frac{1}{r_1 r_2}[r_2^2 + r_1^2 - 2r_1 r_2 cosk(r_2 - r_1)]^{\frac{1}{2}}\right|_{max} \\ \left|\frac{s^2}{r_1^2}\frac{e^{j\cdot k\cdot r1}}{r_1} - \frac{s^2}{r_2^2}\frac{e^{j\cdot k\cdot r2}}{r^2}\right|_{max} = \left|\frac{s^2}{r_1^3 r_2^3}[r_2^6 + r_1^6 - 2r_1^3 r_2^3 cosk(r_2 - r_1)]^{\frac{1}{2}}\right|_{max} \end{Bmatrix} \quad (11)$$

Distance between septum and EUT:

$$r_1 = \sqrt{s^2 + \left(R_g - h_g\right)^2} \quad (12)$$

Distance between the virtual EUT and the receiving antenna:

$$r_2 = \sqrt{s^2 + \left(R_g - h_g\right)^2} \quad (13)$$

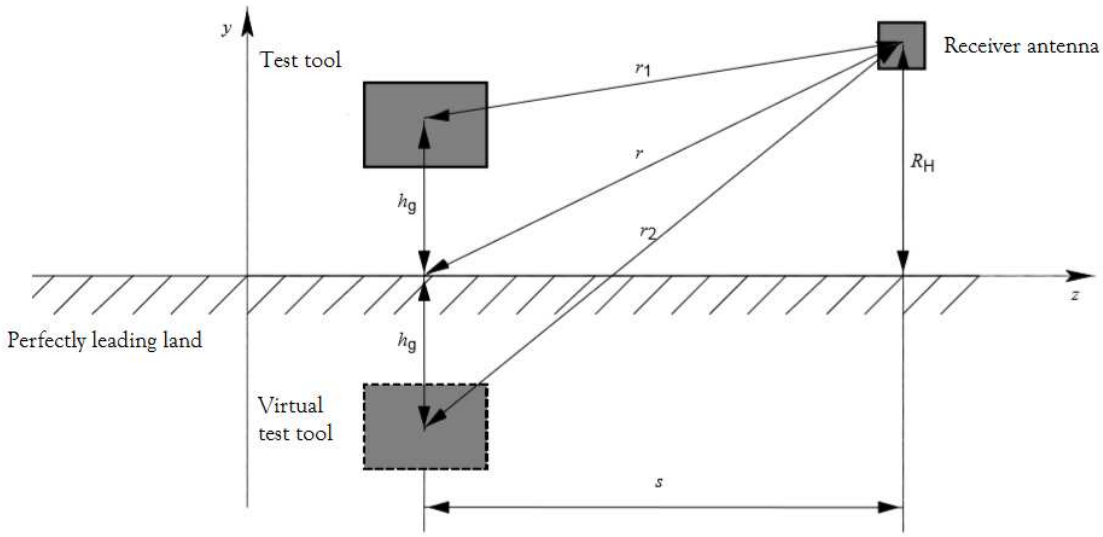

Figure 5. Different measuring positions of the device to be measured (IEC 61000-4-20)

S: receiver antenna distance from EUT: 30m, 10m, 3m;

hg: height from bottom of cell to EUT;

Rh: height of septum from bottom of cell generally: 1m to 4m;

To obtain the result for E_{max} in dB [7]:

$$E_{max}\left[dB\frac{\mu V}{M}\right] = 20\,lg(g_{max}) + 10\,lg(P) + 139.5 \quad (14)$$

From measured voltages:

$$E_{max}\left[dB\frac{\mu V}{M}\right] = 20\,lg(g_{max}) + 20\,lg\left(\left|\frac{\eta k}{2\pi e}\right|\right) + 10\,lg\left(\frac{s^2}{Z}\right) + 120 \quad (15)$$

The $20\lg(g_{max})$formula can be calculated at each point, or conversely, a table of pre-calculated values for standard geometry can be used. Following these steps, it is still possible to refine the measurement given the small test equipment and uncertainty due to the three axes. Small test devices are devices whose size is of the same order of magnitude at a given frequency.

$$c_f = \overline{x_f} - d_{s,f} - t \quad (16)$$

Where:

$\overline{x_f}$: average difference between TEM and OATS field strength;

$d_{s,f}$: the difference between the standard deviations of multiple TEM and OATS readings;

t: radiation factor uncertainty due to rotation.

$$\overline{x_f} = \left(\frac{1}{n}\sum_{i=1}^{n} g_{i,f} - \frac{1}{m}\sum_{k=1}^{m} o_{k,f}\right) \quad (17)$$

$g_{i,f}$: the recalculated value of the TEM electric field to the open space;

i: number of measurements;

n: the number of TEM waveguide measurements;

m: the number of OATS measurements;

$o_{k,f}$: OATS electric field strength;

f: frequency.

$$d_{s,f} = S_{TEM,f} - S_{OATS,f} \quad (18)$$

$$S_{TEM,f} = \sqrt{\frac{\sum_{i=1}^{n}\left(g_{i,f} - \overline{g_f}\right)^2}{n-1}} \quad (19)$$

$$O_{TEM,f} = \sqrt{\frac{\sum_{k=1}^{m}\left(o_{k,f} - \overline{o_f}\right)^2}{m-1}} \quad (20)$$

$$\overline{g_f} = \frac{1}{n}\sum_{i=1}^{n} g_{i,f} \tag{21}$$

$$\overline{o_f} = \frac{1}{m}\sum_{k=1}^{m} o_{k,f} \tag{22}$$

If the aim is to fine-tune the measurement, the test device ought to be measured at multiple angles, such as 0°, 45°, 90°, 135 °, 180°, 225°, 270°, and 315° (standard). This leads to 8x3 measurement results, for which the electric field E for each measuring angle is as follows:

$$\overline{E_0} = \frac{(E_{0^\circ}+E_{90^\circ})}{2}, .., \overline{E_{225}} = \frac{(E_{225^\circ}+E_{315^\circ})}{2} \tag{23}$$

For the E_{max} the larger one is selected, for example:

E_{0max}= max (E0°, E90°).

Standard calculation:

$$t_{90,f} = \sqrt{\frac{\sum_{k=1}^{225^\circ \cap 315^\circ}\left(E_{\alpha,max}-\overline{E_\alpha}\right)^2}{l-1}} \tag{24}$$

l: the number of starting positions.

The uncertainty factor for the final radiation pattern is t their average, or:

$$t = \frac{1}{n}\sum_{i=1}^{n}(t_{90^\circ,f}) \tag{25}$$

2. Measurement with the GTEM cell

There are two types of instruments to measure when measuring:

- small test instrument, the largest size of which is smaller than the maximum wavelength of the signal to be measured,
- a large or medium test device with at least one output wire or a wireless device with a maximum size greater than the wavelength of the highest frequency to be measured.

These two tools need to be distinguished because the correlation equation is to some degree uncertain for small test tools (Bozec, 2004). The inaccuracy stems from the three axial measurement procedures.

To adjust the measured value:

$$c_f = \overline{x_f} - d_{s,f} - t \tag{26}$$

where:

$\overline{x_f}$: average difference between TEM and OATS field strength;

$d_{s,f}$: the difference between the standard deviations of multiple TEM and OATS readings;

t: the uncertainty factor of the radiation factor resulting from the rotation;

$$\overline{x_f} = \left(\frac{1}{n}\sum_{i=1}^{n} g_{i,f} - \frac{1}{m}\sum_{k=1}^{m} o_{k,f}\right) \quad (27)$$

$g_{i,f}$: the recalculated value of the TEM electric field to the open space;

i: number of measurements;

$o_{k,f}$: OATS electric field strength;

f: frequency.

$$d_{s,f} = S_{TEM,f} - S_{OATS,f} \quad (28)$$

$$S_{TEM,f} = \sqrt{\frac{\sum_{i=1}^{n}\left(g_{i,f} - \overline{g_f}\right)^2}{n-1}} \quad (29)$$

$$O_{TEM,f} = \sqrt{\frac{\sum_{k=1}^{m}\left(o_{k,f} - \overline{o_f}\right)^2}{m-1}} \quad (30)$$

$$\overline{g_f} = \frac{1}{n}\sum_{i=1}^{n} g_{i,f} \quad (31)$$

$$\overline{o_f} = \frac{1}{m}\sum_{k=1}^{m} o_{k,f} \quad (32)$$

The radiation pattern uncertainty factor (t) results from the fact that the mentioned three axial measurements can be made from multiple angles, e.g., 0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315° (standard). This will lead to 8x3 measurement results, for which the electric field E for each measuring angle:

$$\overline{E_0} = \frac{(E_{0°} + E_{90°})}{2}, \ldots, \overline{E_{225}} = \frac{(E_{225°} + E_{315°})}{2} \quad (33)$$

For Emax, the larger one from each section is selected, e.g.:

E_{0max}= max (E0°,E90°).

Standard calculation:

$$t_{90,f} = \sqrt{\frac{\sum_{k=1}^{225°\cap 315°}\left(E_{\alpha,max} - \overline{E_\alpha}\right)^2}{l-1}} \quad (34)$$

l: the number of starting positions.

The uncertainty factor for the final radiation pattern is t their average, or:

$$t = \frac{1}{n}\sum_{i=1}^{n}(t_{90°,f}) \quad (35)$$

3. Measuring DC / DC converter with GTEM cell

The investigation of DC-DC converters is crucial as these circuits produce the most EMC noise in the human environment. This is the underlying reason for selecting the Texas Instruments TPS54560EVM-515 Training Model. The used model aims to demonstrate the operation of the TPS54560 Step-Down converter. It allows various measurements to be made at the outgoing measuring points.

Figure 6. The TPS54560EVM-515 Demo Page (*http://www.ti.com/tool/TPS54560EVM-515*)

A Rohde & Schwarz ESCI (ESCI) probe and an ETS-Lindgren 5411 (GTEM) GTEM cell were used to measure the device. Rohde & Schwarz ESCI complies with EMC standards and is therefore well-suited for EMC test ratings in the 9 kHz-3 GHz range. Further, it can also be used as a conventional spectrum analyzer in addition to EMC measurements.

The GTEM cell is capable of measuring emissions and immunity. It is capable of detecting emissions in the 9 kHz - 5 GHz range and immunity can be used in the DC-20GHz range with up to 1 kW radiated power.

Rohde & Schwarz EMC32 software (EMC32) was used for measurement evaluation. This allows the comparison of different measured results. If some parameters are set for the GTEM cell, it will perform the calculations, as well.

The device was measured in three positions (Figure 4):

• laid (X axis),

• opposite the cell's edge (Y-axis),

• facing the top of the cell with its face (Z axis).

The instrument settings were as follows:

• Starting frequency: 30MHz

• final frequency: 1GHz,

• increments of 40kHz

• resolution: 120kHz

• measuring time: 100µs,

• pre-amplification: none,

• auto pre-amplification: none.

Measured values:

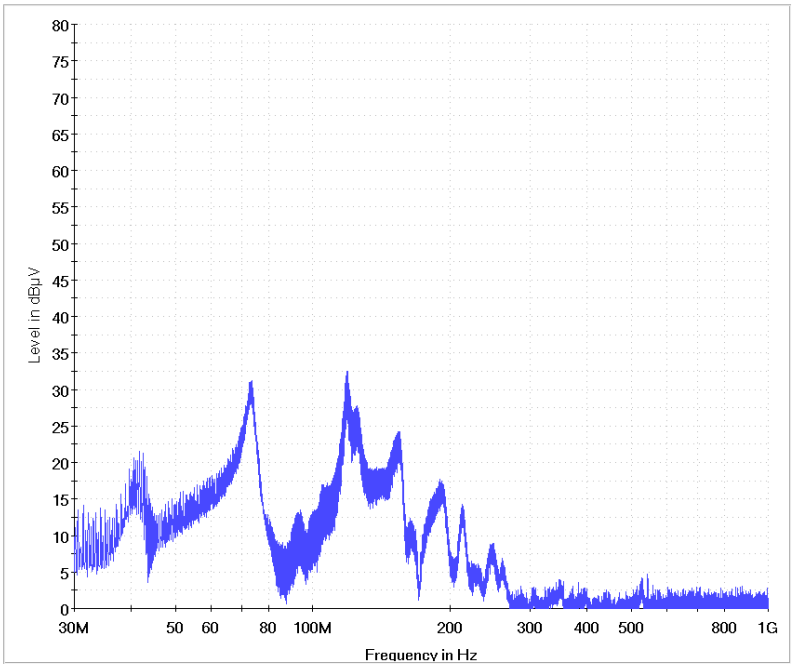

Figure 7. X-axis measurement result *(by Patrik Elter)*

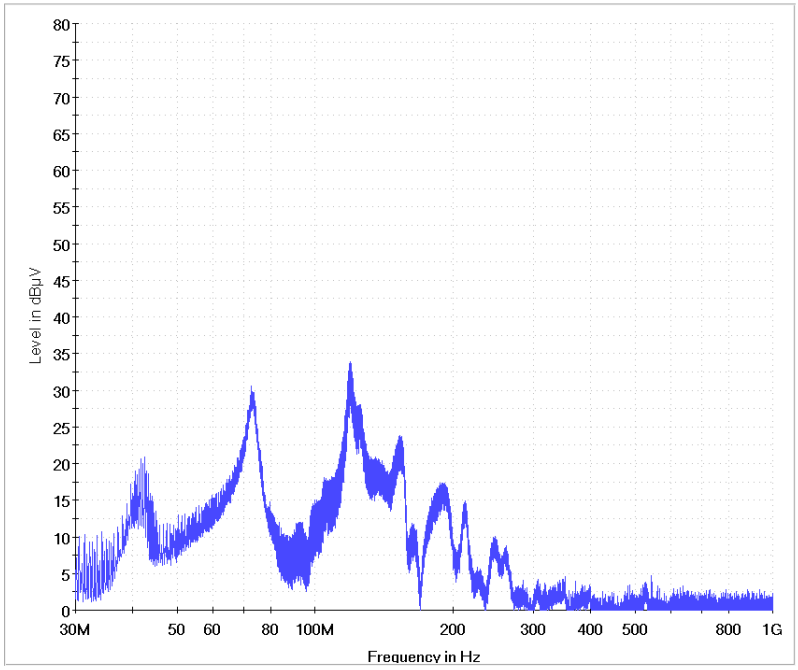

Figure 8. Y-axis measurement result *(by Patrik Elter)*

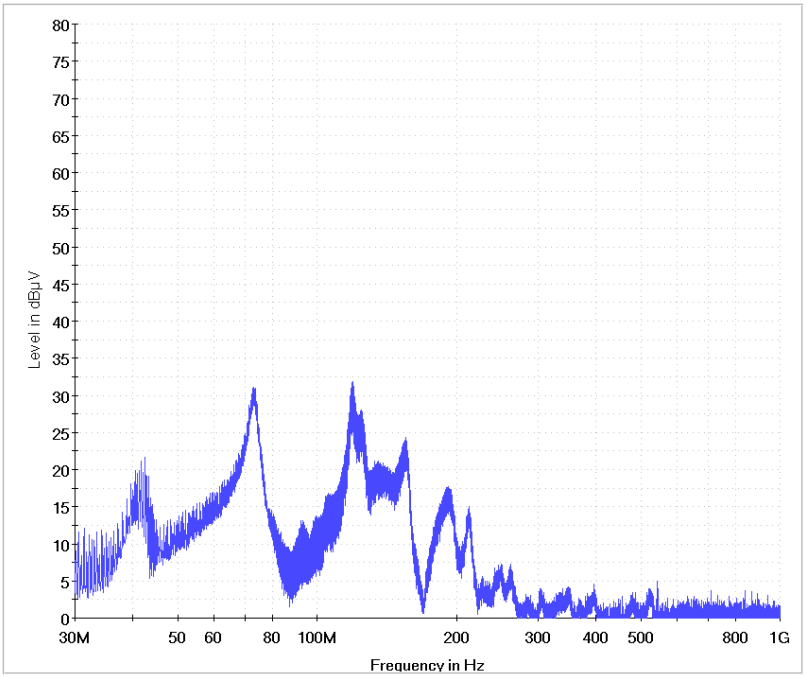

Figure 9. Z axis measurement result (by Patrik Elter)

The three measurements are plotted in the graph below:

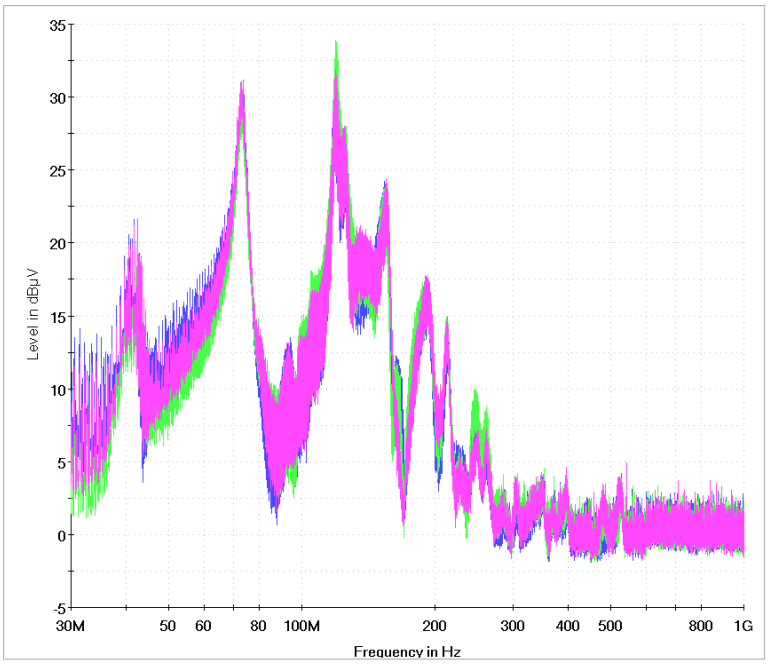

Figure 10. X, Y, Z Combined Measurement Results *(by Patrik Elter)*

Figure 10 shows that there is some difference between the measured values. The difference is caused by the fact that various metal components shield electromagnetic emissions in some directions. But it is also possible that the wires connected to the device will act as antennas at certain positions. The latter case results in highly surprising measurements.

Applying the correlation equation and converting the measured values to open field measurements presents the following graph:

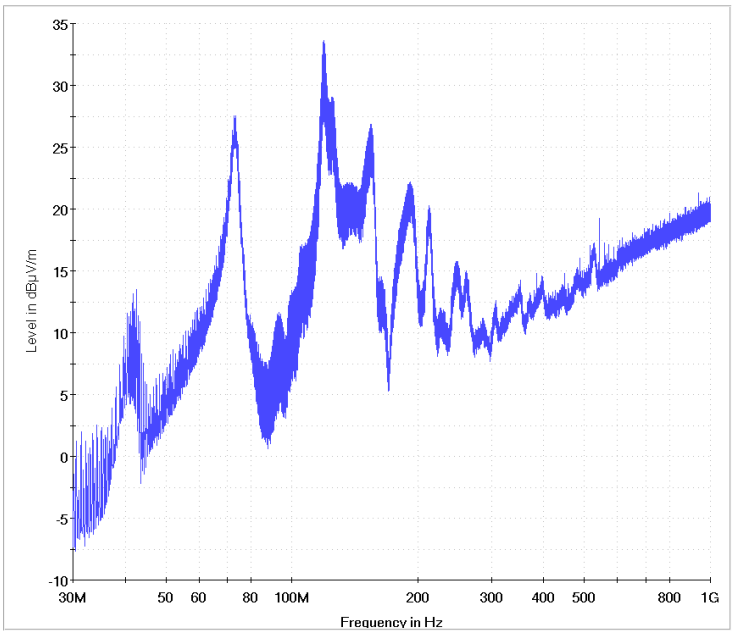

Figure 11. Radiation values converted to OATS *(by Patrik Elter)*

By reading the values of the OATS graph (Figure 11), it can determined for a given test device whether or not it meets the requirements of the standard.

Conclusion

This paper presented the construction of small GTEM cell with low noise power supply module for measuring levels of the radiation from the electronic devices. Test performed in the accredited EMC laboratory confirmed the validity of the performed measurements. GTEM cell performed almost identical to the equipment in the accredited EMC laboratory, but was much smaller and cheaper to construct.

Presented GTEM cell has the advantage of simplifying EMC measurement which could make it valuable in developing and testing of the electronic devices.

Summary

After the measurement, the results were sent to an accredited EMC laboratory where the test instrument was weighed in an echo free EMC chamber. The results obtained were compared with those measured by the authors, presenting only a slight difference, presumably due to measurement inaccuracies.

Since the authors' measured results matched the results of an accredited laboratory, the results were further compared to different standards in order to determine if the test tool matches them.

Two standards were tested on the test device, one for home use and one for the automotive industry.

3.1. EN 55022 classB 10m OATS

The standard specifies measurement procedures and limits set by the European Union for household appliances such as computers in the 9 kHz - 3 GHz range.

The limits prescribed by the standard are given here:

Frequency range (MHz)	Field strength limit (dBmV/m)
30 - 88	39
88 - 216	43.5
216 - 960	46.5
over 960	49.5

Table 1 EN 55022classB 10m limit values (standard)

The current test device fully complied with the limits for home use devices and even had a reserve of 5dBmV / m.

3.2. CISPR 12

The standard describes EMC limits for different vehicles. This standard already sets much stricter values because electrical noise may cause malfunctions in equipment that could even lead to accidents.

Frequency range (MHz)	Field strength limit (dBmV/m)
30 - 230	30
230 - 1000	37

Table 2 CISPR 12 limit values (IEC publication)

At the given limit, the test device does not meet the standard because it exceeds the limit around 110MHz. At the time of measurement, this value may be due to the connecting cables or may actually exceed the limit in the 110MHz environment of the test device.

Measurements have shown that the GTEM cell is highly valuable in developing its own electrical device and can be tested before it is released for sale. Although the presented cell has disadvantages over other EMC measurement procedures, it also features the advantage of greatly simplifying EMC measurement.

Future plans at the University of Pécs Faculty of Engineering and Information Technology include the involvement of electrical engineers and engineering IT students in EMC measurements, as well as the testing of various PCB designs, high-speed communication buses, and power electronics using the GTEM cell.

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Some ethical hacking possibilities in Kali Linux environment

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Abstract

This paper deals with the problem of ethical hacking and security of computer systems. When we talk about security of an information system, we actually mean the primary three attributes of the system: confidentiality, integrity and availability. There are various approaches with aim to identify existing security weaknesses and security assessment. One of them is using Kali Linux operating system with its integrated effective tools specially adapted to the realization of various types of attacks. The paper gives a general overview of some Kali attacking possibilities on client and server side and highlights their specificities. The undoubted benefit of this operating system is a large collection of different hacking tools in one place which significantly facilitates vulnerability assessment and security testing.

Keywords: Kali Linux; tools; attack; security; ethical hacking

1. Introduction

In general, four main categories (or phases) of information security assessments can be identified (Hertzog, 2017): a vulnerability assessment, a compliance (audit) test, a traditional internal/external penetration test, and an application assessment. There are various methods with aim to identify existing security weaknesses and security assessment (Allen, 2014). One of them is using tools from Kali Linux operating system (OS).

Kali Linux is a Debian-based Linux distribution focused on advanced penetration testing and ethical hacking. It contains several hundred tools which are aimed at a wide range of information security tasks, such as penetration testing, security examinations, computer forensics and reverse engineering (Pritchett, 2013). The term hacking refers to identifying and exploiting security weaknesses in computer systems and/or networks.

Tools within Kali package are very diverse and can be divided into the following categories (Kali Linux Tools): Information gathering, Vulnerability analysis, Wireless attacks, Web applications, Exploitation tools, Forensics tools, Stress testing, Sniffing and spoofing, Password attacks, Maintaining attacks, Reverse engineering, Hardware hacking and Reporting tools (Fig. 1).

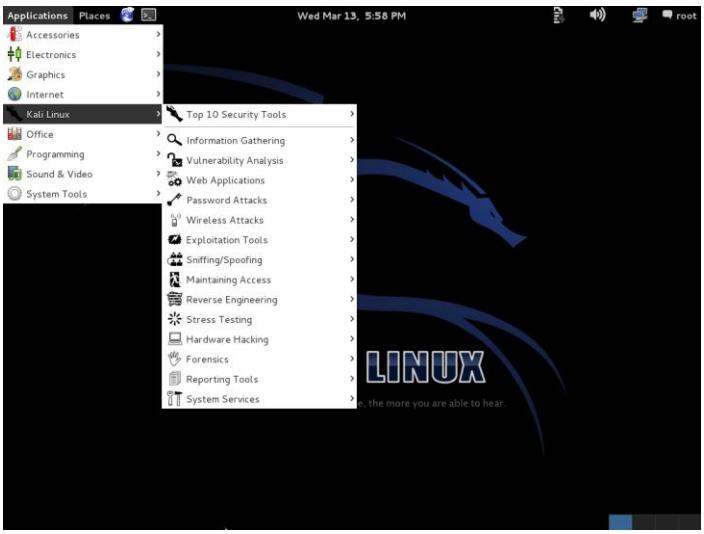

Fig. 1. Kali Linux integrated tools

Kali Linux contains frequently used security testing tools such as: Nmap (port scanner), Wireshark (packet analyzer), John The Ripper (password cracker), Aircrack-ng (software suite for penetration testing wireless LANs), Nikto (web server scanner), Sqlmap (tool for detecting and exploiting SQL injection flaws and taking over of database servers), Owasp-Zap (finding vulnerabilities in web applications), Metasploit Framework (exploitation) and many others.

In addition to Kali distribution as the most popular, other Linux distributions are also used for hacking (It's FOSS). They provide various tools that are needed for assessing networking security:

- BackBox is Ubuntu-based distribution developed for penetration testing and security assessment. It has own software repository providing latest stable versions of various system and network analysis toolkits and the best known ethical hacking tools. BackBox is designed with minimalism and uses XFCE (XForms Common Environment) desktop environment. It delivers a fast, effective and customizable work.

- Parrot Security OS is a relatively new hacking distribution. The target users are penetration testers who need cloud friendly environment with online anonymity and encrypted system. Parrot is also based on Debian and uses MATE as its desktop environment. A great number of tools for penetration testing are available here (along with some exclusive custom tools from Frozenbox Network).
- BlackArch is a penetration testing and security researching distribution built on Arch Linux. BlackArch has its own repository containing thousands of tools organized in various groups.
- Bugtraq is a distribution with a great range of penetration, forensic and laboratory tools. It is available with XFCE, GNOME and KDE desktop environments based on Ubuntu, Debian and OpenSUSE. Bugtraq contains a huge collection of penetration testing tools, mobile forensics and malware testing laboratories along with tools designed by the Bugtraq-community.
- DEFT (Digital Evidence & Forensics Toolkit) Linux is a distribution made for computer forensics, with the purpose of running live system without corrupting or tampering devices connected to the computer where the booting takes place. DEFT is combined with DART (Digital Advanced Response Toolkit), a forensics system for Windows OS. It uses LXDE desktop environment and WINE for running Windows tools.
- Samurai Web Testing Framework is developed with the sole purpose of penetration testing on web. Another difference from the previous distributions is that it comes as a virtual machine, supported by Virtualbox and VMWare. Samurai Web Testing Framework is based on Ubuntu and contains free and open source tools focusing on testing and attacking websites.
- Pentoo Linux is based on Gentoo Linux. It is a distribution focused on security and penetration testing and is available as Live CD with persistence support (any changes made in the Live environment will be available on the next boot if using a USB stick). Pentoo contains a number of customized tools and kernel features and uses XFCE desktop environment.
- CAINE (Computer Aided Investigative Environment) is completely focused on digital forensics. CAINE comes with a wide variety of tools developed for system forensics and analysis purpose.

- Network Security Toolkit is a bootable Live ISO (Live CD) based on Fedora. It provides a wide range of open source network security tools and has an advanced Web user interface for system / network administration, navigation, automation, network monitoring and analysis and configuration of many applications which can be found in this distribution.
- Fedora Security Spin represents a variation of Fedora designed for security auditing and testing and can also be used for teaching purpose. The main goal of this distribution is to help students and teachers in practicing and learning security methodologies on information security, web application security, forensics analysis etc.
- ArchStrike (former ArchAssault) is a distribution based on Arch Linux convenient for penetration testers and security professionals. It comes with all functionalities of Arch Linux, expanded with tools for penetration testing and cyber security. ArchStrike includes thousands of tools and applications, categorized into modular package groups.
- Other Linux hacking distributions: Cyborg Linux, Matriux, Weakerth4n etc.

Kali distribution was chosen for presentation in this paper because of its ease installation, ability to work in virtual environment, a large number of reliable security testing tools, and convenience for student training.

Attack is the basic form of hacking and can be defined as any action that compromises the security of information.

One of the most common vulnerability classes (attacks) are (Hertzog, 2017): denial-of-service (DoS; breaks the behavior of an application and makes it inaccessible), memory corruption (e.g. buffer overflow; leads to manipulation of process memory, often allowing an attacker code execution), Web vulnerabilities (which attack web services using techniques like SQL injection and XSS), password attacks (attacks against the authentication system; often leverage password lists to attack service credentials) and client-side attacks.

The process of network hacking can take many forms: pre connection attacks (packet sniffing, deauthentication attack), gaining access (cracking WEP/WPA/WPA2 encryption), post connection attacks (using network mapping with Nmap/Zenmap, Man-in-the-middle attacks, using of Wireshark, creating fake access points, spying, pivoting) and website hacking.

Speaking of ethical hacking, gaining access to computer device (personal computer, web server, network, mobile phone, TV and so on) is essential activity and can be practically realized by two different types of attack:

a) client side attack
b) server side attack

2. Client side attack

This type of attack requires some kind of user interaction, such as opening a specific file or a link. Information gathering is vital here, as well as creation and distribution of Trojans and use of social engineering to make target to run them. It is necessary to be positioned like a man-in-the-middle (MITM) - a network situation where the attacker is secretly placed between two participants, who believe they are directly communicating.

This type of attack is mostly launched in the following cases:

- If server side attacks fail (after unsuccessful attempts of using exploits in OS and application installed).
- If IP is probably useless (after pinging the target IP, the target stays hidden behind the router or a network).

Social engineering can be very useful for gathering information about the user(s) (Ex. name, Facebook account, password etc.), for building a strategy based on the information, to create backdoor based on information (the target runs the specific file or downloads some executables).

Protection against this type of attack (smart delivery methods) involves:

- Ensuring of not being in MITM situation - by usage of trusted networks or appropriate software (for instance, XArp).
- Only perform download from HTTPS (Hypertext Transfer Protocol Secure) pages.
- Checking file's MD5 signature (checksum) after download (for example, WinMD5Free tool makes it possible to compare original (provided by the developer or the download page) and current file's MD5 checksum values) - matching these values ensures that the file has not been modified or infected with backdoor malware.

One of the common forms of attack on the client side is the insertion of a Trojans into the client device. Existing of Trojans can be checked in many ways - manually or using a sandbox environment:

- Manually:
    a) Checking the properties of the suspicious file: the right click on file icon → Properties → Type of file. In this way, it can be determined whether the observed file is what it appears to be.

b) Resource Monitor - choice of Network option gives all the opened ports on the machine. Remote Address option displays all active IP addresses in that moment (Fig. 2). A suspicious (unknown) address should be identified among them. That address can be verified with Reverse DNS Lookup (lookup an IP address).

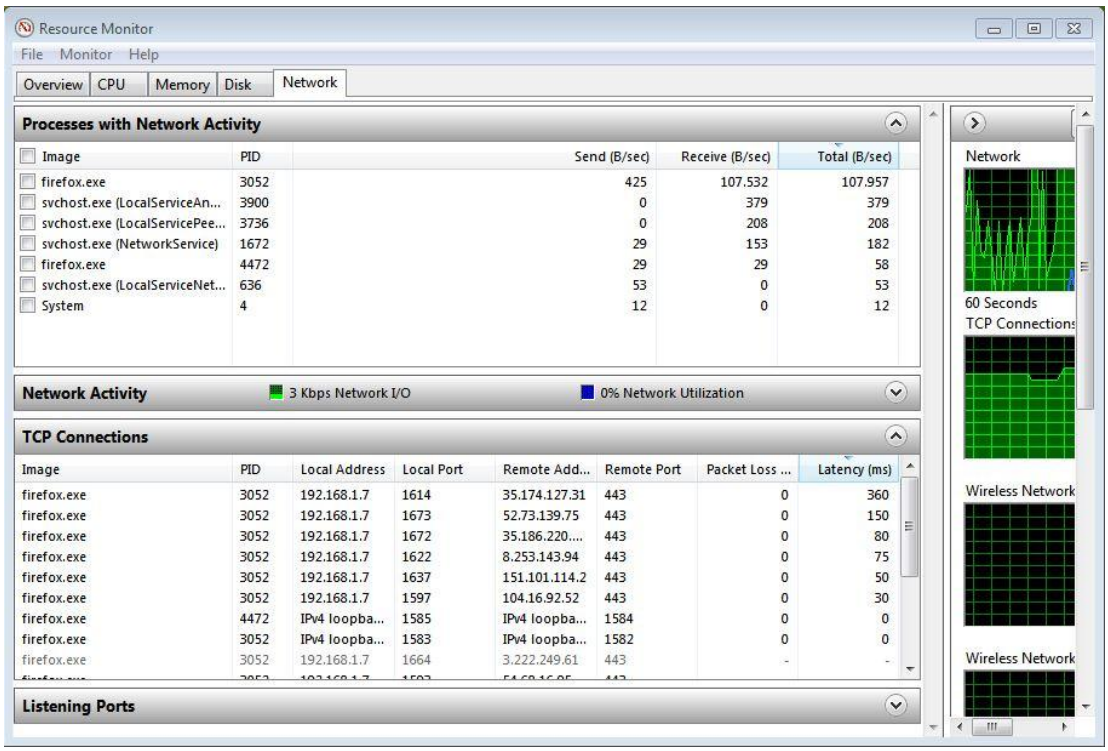

Fig. 2. Resource Monitor - identification of active TCP connections

- Running the file in a virtual machine and checking resources.
- Use of online sandbox service (malware analysis service) - a place where the file will be executed and analyzed with generating a detailed report (Fig. 3).

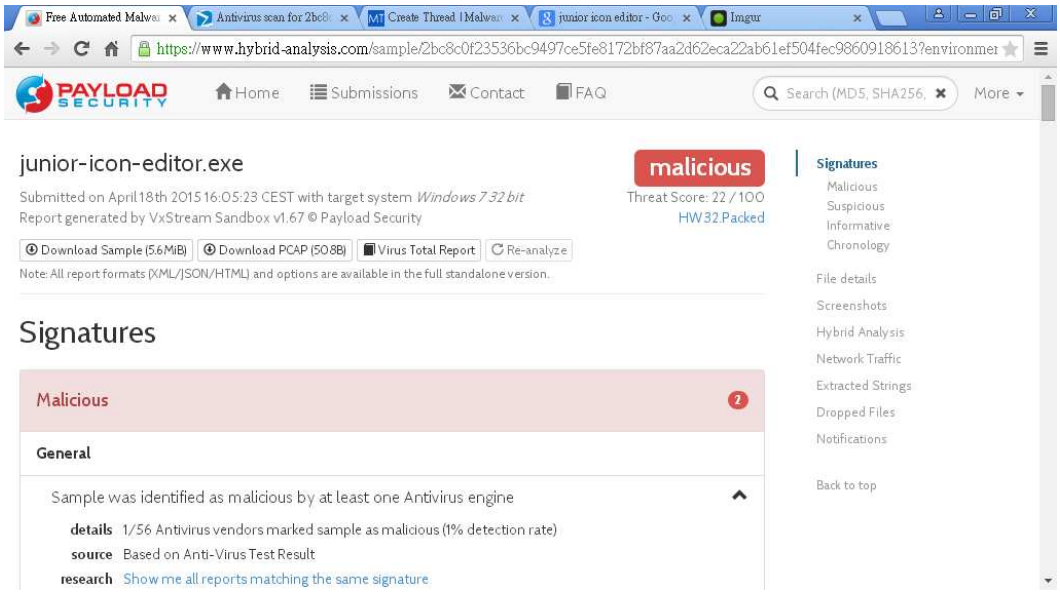

Fig. 3. Malware analysis (Hybrid Analysis)

3. Server side attack

This type of attack does not require any user interaction. All it takes is the target IP address. If this data is known, information gathering can start, followed by finding open ports, identification of operation systems, installed services and work from there.

Server side attack is very simple if identified target is on the same network (using tools like Netdiscover or Zenmap).

If a target has a domain, then running simple `ping` command will return its IP (for instance, `ping` www.facebook.com → 31.13.84.36).

Getting the IP is more complicated if the target is a personal computer. This might be useless if the target is accessing the internet through a network as the obtained IP will be the router's IP and not the target's. Client side attacks are more effective in this case as reverse connection can be used.

4. Packet sniffing

Packet sniffing is the activity of capturing packets of data flow across a computer network. The software or device used to do this is called a packet sniffer (Colasoft).

The process of packet sniffing in Kali Linux is a part of the Aircrack-ng suit (by `airodump-ng` sniffing tool). This tool is designed and used to capture all packets within range. It displays detailed information about networks (devices) around observed computer, connected clients etc. (Fig. 4).

Targeted packet sniffing is also supported and is based on BSSID (Basic Service Set Identifier) and channel or MAC address of the target.

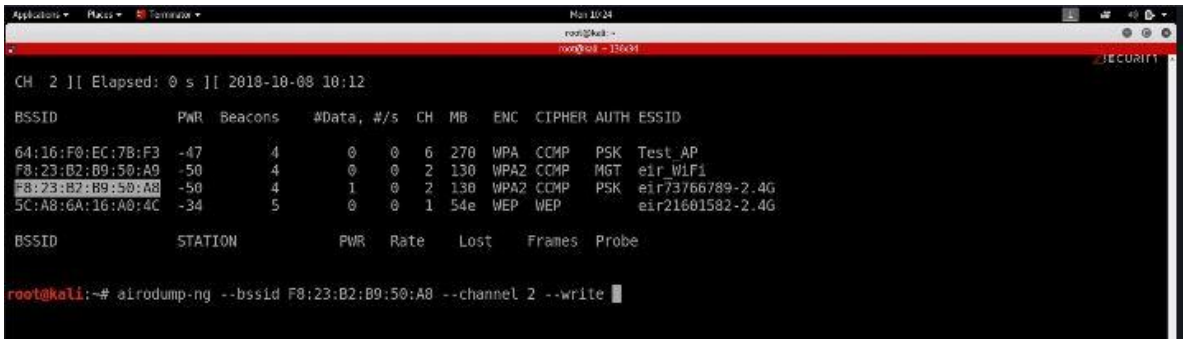

Fig. 4. Packet sniffing by *airodump-ng*

5. Deauthentication attack

Deauthentication attack is a type of attack which is focused on disconnecting any client (device) from any network (router). It belongs to the DoS (Denial-of-Service) attack category.

The main features of this type of attack are:

- Works on encrypted networks (WEP, WPA and WPA2).
- No need to know the network key.
- No need to connect to the network.

The attacker sends deauthenication packets (protocol - spoofed deauthentication message) to an access point, forcing the device to disconnect - telling it that it has been disconnected.

Example: `aireplay-ng --deauth 4(0 ili 1)`(number of authentication packets) `-a 00:10:18:90:2D:EE`(BSSID) `-c C0:18:85:C1:CF:01`(STATION) `mon0`

6. MITM attack - ARP poisoning theory

MITM attack is a general term for attack situation where an executor places him in a connection between a user and a web application - either to eavesdrop or to represent one of the parties, making it appear (establishing new connection) as if a normal information exchange is on-going (Imperva).

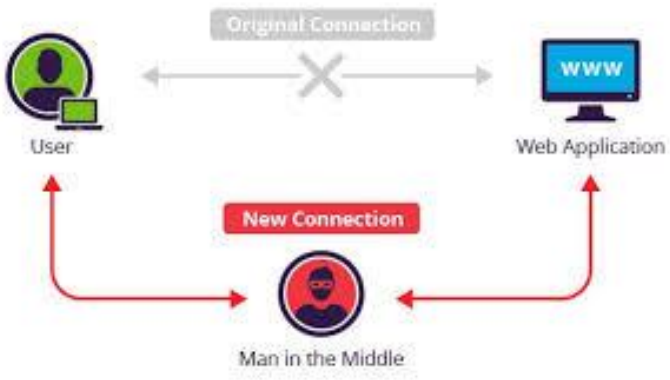

Fig. 5. Man-in-the-middle attack - basic principle

ARP spoofing is a type of attack in which a hacker sends falsified ARP (Address Resolution Protocol) messages over a local area network. This results in the linking of a hacker's MAC address with the IP address of a legitimate user or server on the network. Once the hacker's MAC address is connected to an authentic IP address, the hacker will begin receiving any data that is intended for that IP address. ARP spoofing can enable malicious persons to intercept,

modify or even stop data in-transit. ARP spoofing attacks can only occur on local area networks that utilize the ARP (Veracode).

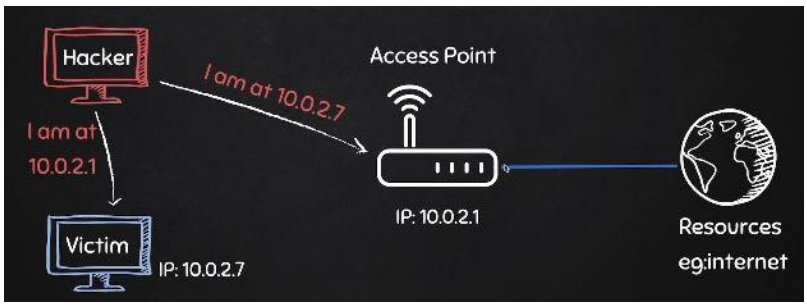

Fig. 6. ARP spoofing - example (Udemy)

ARP spoofing the following facts make possible:

1. Clients accept responses even if they did not send a request.
2. Clients trust response without any form of verification.

Prevention - Several methods can be used to prevent ARP poisoning, each with its own positives and negatives. These include static ARP entries (recommended for smaller networks), encryption (HTTPS, SSH), VPNs (VPN encrypt all of the data that travels between the client and the exit server), packet filters (packets that come from outside the network but contain source IP of inside the network should not be allowed) and software for detection of ARP Spoofing (for example, XArp). The most common detection criterion is unknown MAC address and host (marked in the figure below).

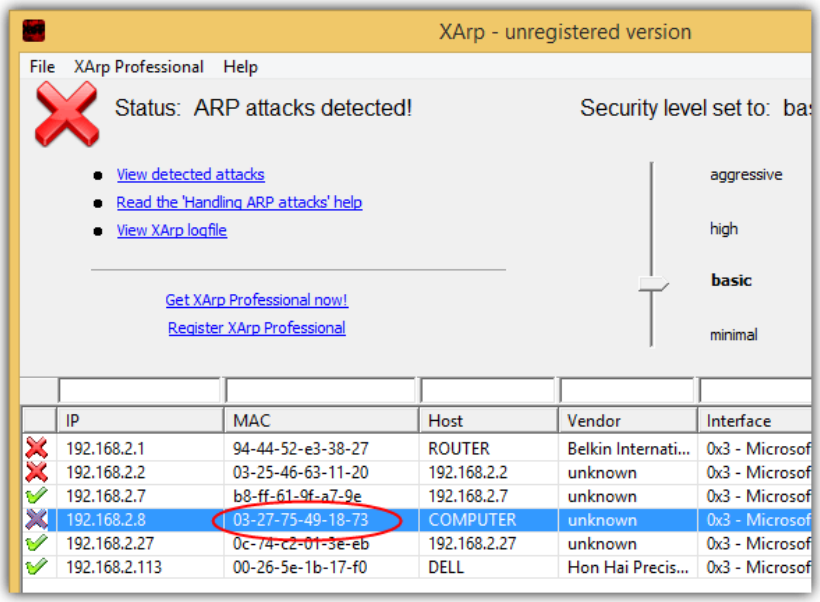

Fig. 7. XArp - ARP attack detection

7. MITM - Bypassing HTTPS

A general problem with HTTP protocol is that data is sent as plain text (the attacker is able to see usernames, passwords and all other sensitive data). This practically means that a MITM can read and edit requests and responses, causing unsecure communication.

Solutions for ensuring satisfactory security at the transport level:

- Using of HTTPS (HTTPS is an adaptation of HTTP).
- Encryption of HTTP using TLS (Transport Layer Security) or SSL (Secure Sockets Layer).

Problem that occurs with bypassing HTTPS is that most websites use HTTPS → sniffed data will be encrypted. Solution for this is to downgrade HTTPS to HTTP - by adequate using of `bettercap` program (network tool in Kali Linux for network capture, analysis and MITM attacks) and recorded caplets in HTTPS.

8. MITM - Bypassing HSTS

HTTP Strict Transport Security (HSTS) is a kind of web server security mechanism which over header informs user agents and web browsers that they should never load a site using HTTP and should automatically convert all attempts to access the site using HTTP to HTTPS requests instead (MDN Web Docs). HSTS is used by Facebook, Twitter and few famous websites.

A problem with bypassing HSTS is that modern browsers are hard-coded to only load a list of HSTS websites over HTTPS. Attempt to resolve this situation is to trick the browser into loading a different websites - replacing links for HSTS websites in HSTS caplets (.cap files) with similar (slightly modified) links (Ex. facebook.com → facebook.corn, twitter.com → twiter.com). Caplet is a configuration file containing a list of scripts - commands for interactive sessions. Running this file in Bettercap program will activate entered modifications (`hstshijack/hstshijack`).

Example: `hstshijack.cap`

```
set hstshijack.log
      /usr/share/bettercap/caplets/hstshijack/ssl.log

set hstshijack.ignore   *

set hstshijack.targets
      twitter.com,*.twitter.com,facebook.com,*.facebook.com
```

```
set hstshijack.replacements
      twitter.corn,*.twitter.corn,facebook.corn,*.facebook.corn

set hstshijack.obfuscate      false

set hstshijack.encode         false

set hstshijack.payloads
      *:/usr/share/bettercap/caplets/hstshijack/payloads/keylogger.js


set http.proxy.script         /usr/share/bettercap/caplets/hstshijack/
hstshijack.js

set dns.spoof.domains
      twitter.corn,*.twitter.corn,facebook.corn,*.facebook.corn

http.proxy  on

dns.spoof   on
```

9. MITM - DNS spoofing attack

DNS cache poisoning (also known as DNS spoofing) is a type of attack that exploits vulnerabilities in the domain name system (DNS) to divert traffic away from legitimate website and towards fake ones (Fig. 8). The attack principle is based on falsifying DNS records with aim of traffic redirection. One of the reasons DNS poisoning is dangerous is because it can spread from DNS server to DNS server.

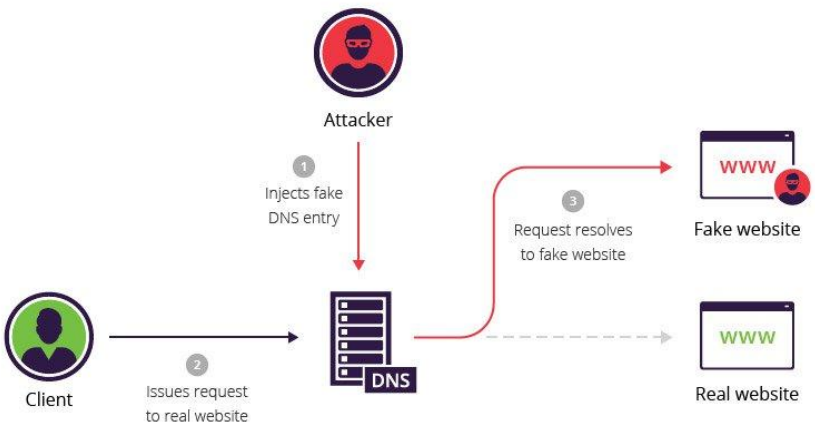

Fig. 8. DNS spoofing attack (Imperva)

Various tools can be used to launch this attack. Arpspoof from Kali Linux collection is one of them. The attacking procedure using this program consists of the following steps:

1. Finding own default gateway - `#ip route`
2. Finding the network interface - `#ifconfig`
3. Finding the IP address of victim - `#ifconfig or netdiscover -r Default Gateway`
4. Starting the ARP poisoning/spoofing - `#arpspoof -i [Network Interface Name] -t [victim IP] [Router IP]/[-r Default Gateway]`

where `i` is for interface, `t` is for target and `r` is for default gateway.

During ARP spoofing the target has no internet connection. When the attack is stopped, the internet connection starts working again.

10.**MITM - code injection attack**

Code injection is the activity that enables the attacker to execute some specific code as a consequence of security vulnerabilities in web applications. Attacking possibilities depend on the limitations of the server-side interpreter (Python, Ruby, ASP, PHP, etc.). There are a few types of code injection attacks (The Security Buddy): SQL injection, HTML (JavaScript) injection, Dynamic code evaluation, File inclusion, Shell injection or Command injection.

One of the common forms of this attack is JavaScript code injection (can be realized by Bettercap program) in loaded pages. Code gets executed by target browser - the situation called remote code execution (RCE).

Code injection can be used to:

- ✓ replace links
- ✓ replace images
- ✓ insert HTML elements
- ✓ hook target browsers to exploitation frameworks
- ✓ ...

11.**Creating a fake access point (honeypot)**

A fake access point (AP), also known as honeypot, is an access point which broadcasts its signal the same way a router and even works like a router does but in reality it gathers packets from its clients which effectively means all data is streamed through the honeypot and the packets are open to modification and sniffing (Medium).

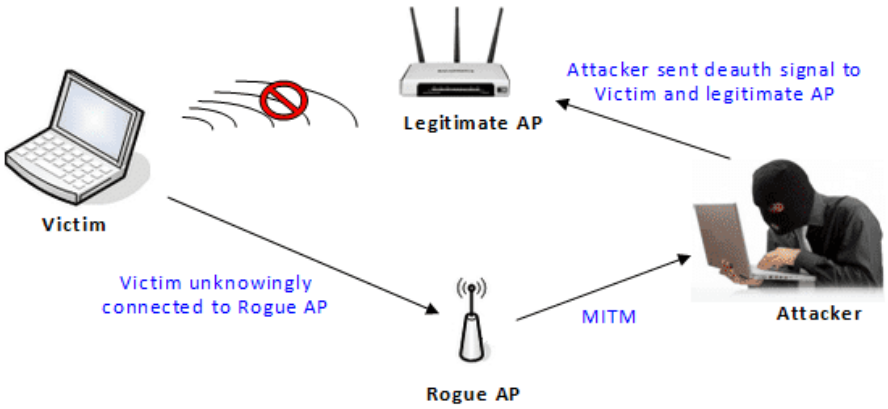

Fig. 9. Fake access point (Medium)

Mana-toolkit is a set of tools that run rogue access point attacks and wireless MITM. It can:

- ✓ Automatically configure and create fake AP.
- ✓ Automatically sniff data.
- ✓ Automatically bypass HTTPS.
- ✓ etc.

Mana has three main start scripts:

`start-noupstream` - starts an AP with no internet connection

`start-nat-simple` - starts a regular AP using internet connection in the upstream interface

`start-nat-full` - starts AP with internet connection and also starts sslstrip, sslsplit, firelamp and attempts to bypass HSTS.

12.MAC address and the ability of its modification

A MAC (Media Access Control) address is a hardware identification number that uniquely identifies each device on a network. The MAC address is manufactured into every network card (Ethernet card or Wi-Fi card), and therefore cannot be changed (Tech Terms).

MAC address is:

- Permanent
- Physical
- Unique

In Kali Linux, an easy way to determine the MAC addresses of installed network cards is to execute a command `ifconfig` for network interface configuration (Fig. 10).

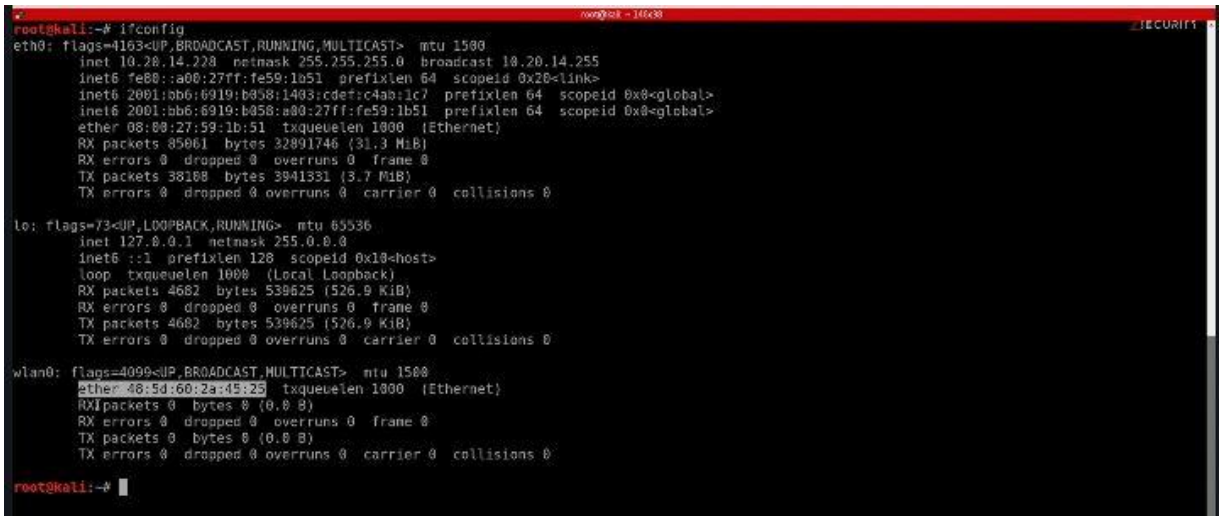

Fig. 10. MAC address determination (`ifconfig`)

In certain hacking situations, it is necessary to temporarily change the MAC address (in memory). The reasons for this could be:

- increase anonymity
- impersonate other devices
- bypass filters

The change process consists of the following steps:

1. Disable the interface (`ifconfig wlan0 down`).

2. Change the option (`ifconfig wlan0 hw ether 00:11:22:33:44:55; ifconfig wlan0 up`)

Restarting (reset) the computer brings back the original (physical) MAC address.

13.**Post exploitation (after gaining access)**

One of the most common post exploitation activities are:

- spying - capturing key strikes and taking screenshots of the target computer.
- pivoting - using a hacked device as a pivot, with aim to gain access to other devices in a network by Autoroute program (for setting up a route between hacker and hacked device, which gives hacker access to devices on the network.).

After exploiting a system there are two different approaches that can be applied - either smash and grab or low and slow. One tool which can be used for low and slow information gathering is the keystroke logger script with Meterpreter. This tool is very well designed, allowing capturing all keyboard inputs from the system, without writing anything to disk, leaving a minimal forensic footprint for investigators to later follow up on. It is perfect for getting

passwords, user accounts, and all sorts of other valuable information (https://www.offensive-security.com/metasploit-unleashed/keylogging/).

For instance:

`>keyscan_start` - shows current working directory

`>keyscan_dump` - lists files in the current working directory

`>keyscan_stop` - changes working directory to [location]

`>screenshot`

14. Website hacking

A website can be hacked on different ways, depending on what the hacking activities are oriented to:

- Attack on application installed on a computer → web application pentesting
- Attack on computer that uses an OS + other applications → server side attacks
- Attack on Website managed by humans (administrators) → client side attacks

Website hacking consists of several phases:

1. Information gathering (IP address, domain name information, used technologies, other websites on the same server, DNS records, unlisted files, subdomains, directories)

Important activities from this phase are: gathering basic information, discovering technologies used on the website, gathering comprehensive DNS information, discovering websites on the same server, discovering subdomains, and discovering and analyzing discovered sensitive files.

Useful tools used for this purpose:

- Whois Lookup - basic information about the owner of the target (Whois Lookup)
- Netcraft Site Report - shows technologies used on the target (Netcraft)
- Robtex DNS Lookup - shows comprehensive information about the target website (Robtex)
- `dirb` (Web content scanner) - `dirb [target][wordlist][options]`

2. File upload, code execution and file inclusion vulnerabilities

Important activities from this phase are:

- Discovering and exploiting file upload vulnerabilities - allow users to upload executable files (such as php) - tool `weevly` (generate backdoor, upload generated file and connect to it)

- Discovering and exploiting code execution vulnerabilities - allows an attacker to execute OS commands, Windows or Linux commands, can be used to get a reverse shell or upload any file using `wget` command, code execution commands attached in the resources.

- Discovering and exploiting local file inclusion vulnerabilities

- Discovery and exploitation of remote file inclusion vulnerabilities

Prevention from these vulnerabilities:

- File upload vulnerabilities - Only allow safe files to be uploaded - not php or any executables
- Code execution vulnerabilities - don't use dangerous functions (that use OS, filter user input before execution)
- File inclusion - disable `allow_url_fopen` and `allow_url_include`

3. SQL injection vulnerabilities

Most websites use a database to store data. Most data stored in it have sensitive character (usernames, passwords, pictures etc.). Web application reads, updates and inserts data in the database. Interaction with database is done by the language called SQL (Structured Query Language).

Important activities from this phase are:

- Discovering SQL injections in POST/GET

- Bypassing logins using SQL injection vulnerability - for example, `username='admin' and password='aaa' or 1=1 #'`

- Finding and reading database tables

- Extracting sensitive data - passwords

- Reading and writing files on the server using SQL injection vulnerability

- Discovering SQL injections and extracting data using SQLmap

Prevention from these vulnerabilities: using of parameterized statements in (server side language) code, separate data from SQL code.

4. Cross-site scripting (XSS) vulnerabilities

XSS allow an attacker to inject JavaScript code into the page. This code is executed on the client machine (not the server) when the page loads. There are three main types of XSS: persistent / stored (the injected code is stored in database), reflected (the code is only executed when the target user runs specific URL written and sent by attacker) and DOM based (results from JavaScript code written on the client machine).

Important activities from this phase are: discovering reflected and stored XSS and exploiting XSS - hooking vulnerable page visitors to BeEF (Browser Exploitation Framework - a penetration testing tool that focuses on the web browser).

Prevention from these vulnerabilities includes minimizing the usage of untrusted user input on HTML and escaping any untrusted input before inserting it into the page.

5. Discovering vulnerabilities automatically - OWASP ZAP (Open Web Application Security Project - Zed Attack Proxy)

This is a tool for scanning target website for vulnerabilities and analyzing scan results - the target URL needs to be entered (Fig. 11).

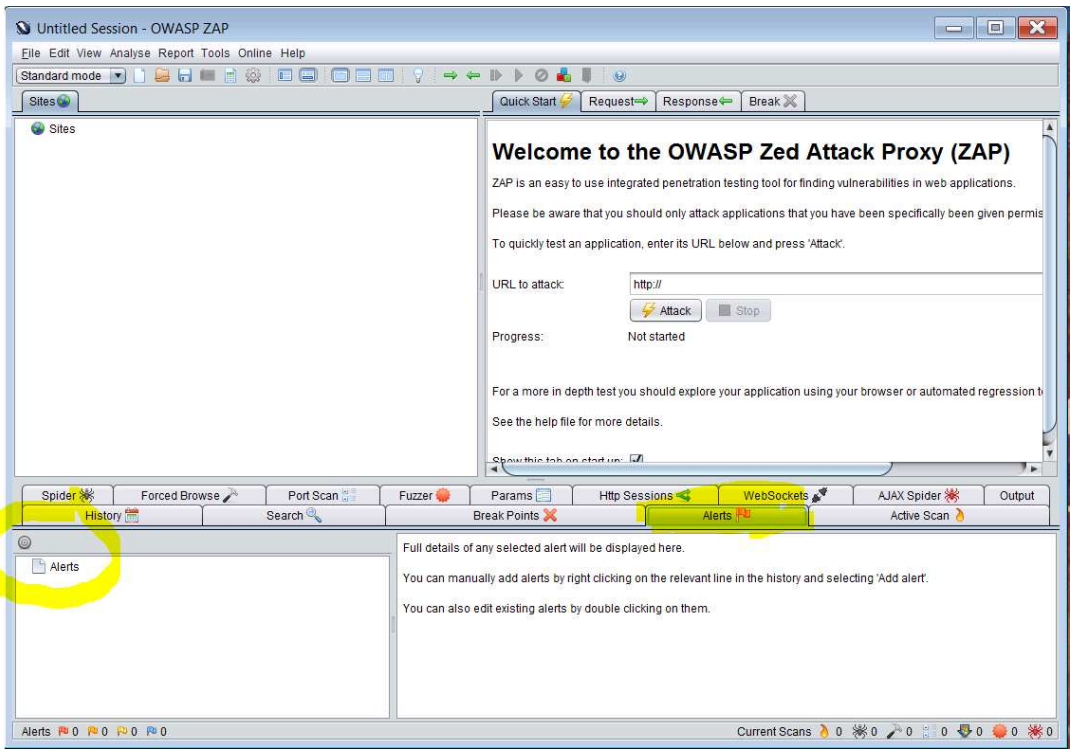

Fig. 11. ZAP (main screen)

For instance, the web application penetration testing methodology based on OWASP consists of 12 subcategories (OWASP): 1. Introduction and Objectives 2. Information Gathering 3. Configuration and Deploy Management Testing 4. Identity Management Testing 5. Authentication Testing 6. Authorization Testing 7. Session Management Testing 8. Data Validation Testing 9. Error Handling 10. Cryptography 11. Business Logic Testing 12. Client Side Testing.

15. **Best Kali tools**

The best Kali tools can be summarized in the following table (Linuxhint).

Table 1. The best Kali tools

Name	Function
Metasploit Framework	modules for automation the process of exploiting
Wireshark, Bettercap	sniffing and spoofing
Social Engineering Toolkit (SET)	exploitation tool
Aircrack-NG Suite	wireless attack
THC Hydra	online password cracker
John The Ripper	offline password cracker
Crunch	utility to create custom wordlists
Hash-Identifier and findmyhash	password attacks
SQLMap	detecting and exploiting SQL injection vulnerabilities
JoomScan & WPScan	tool to scan and analyze Joomla / WordPress CMS (content management system)
Httrack	website / webpage cloner
OWASP-ZAP	testing web application security
Burp Suite	mapping and analysis of an application's attack surface, finding and exploiting security vulnerabilities
SQLiv	SQL injection scanner
Nikto	vulnerability analysis
Dirbuster (Dirb)	tool to find hidden objects, files and directories on a website
NMap	network discovery and

	security auditing
Maltegoce (Maltego Community Edition)	tool to discover and collect data about the target and visualizes that collected data into graph for analysis
Whois	querying databases that store the registered users of an Internet resource (domain name or an IP address block)
WhatWeb	website identification, including CMS, blogging platforms, statistic/analytic packages, JavaScript libraries, web servers, and embedded devices
Traceroute	displaying the connection route and measuring transit delays of packets across an IP network
Proxychains	cover and handle whatever job
MacChanger	changing the MAC address

16. **Conclusions**

Kali Linux is an OS with numerous integrated effective tools specially adapted to the realization of various types of attacks. The paper emphasized the importance of Kali attacking possibilities in form of pre connection attacks, gaining access, post connection attacks and website hacking and highlighted their specificities. The undoubted benefit of this OS is a large collection of different hacking tools in one place which significantly facilitates vulnerability assessment and security testing.

This OS is open source system and can be easily accessed by the users. All the codes in the Kali Linux can be viewed easily by anyone and the open development Git tree makes easy to view the development of coding at every step.

Kali adheres to the FHS (File-system Hierarchy Standard), allowing Linux users to easily locate binaries, support files, libraries, etc. This is the very important feature of the Kali Linux that makes it stand out among the other Linux systems.

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Whois Lookup http://whois.domaintools.com/

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